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JOURNAL
OF THE
ROYAL
MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,
AND A SUMMARY OF CURRENT RESEARCHES RELATING TO
ZOOLOGY AND BOTANY
(principally Invertebrata and Cryptogamia),
MICROSCOPY, &c.

Edited by

F. JEFFREY BELL, M.A.,

One of the Secretaries of the Society

and Professor of Comparative Anatomy and Zoology in King's College ;

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

A. W. BENNETT, M.A., B.Sc., F.L.S.,
Lecturer on Botany at St. Thomas's Hospital,

R. G. HEBB, M.A., M.D. (Cantab.), AND

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*Lecturer on Zoology in the School of Medicine,
Edinburgh,*

FELLOWS OF THE SOCIETY.

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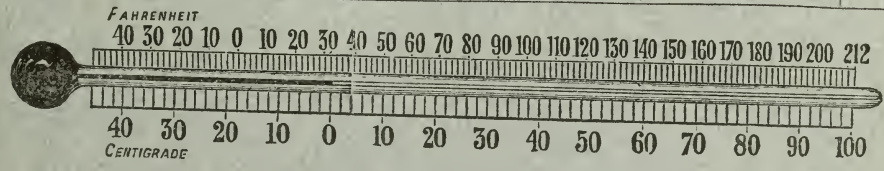
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APERTURE TABLE.

Numerical Aperture. ($n \sin u = a$.)	Corresponding Angle ($2u$) for			Limit of Resolving Power, in Lines to an Inch.			Illuminating Power. (a^2 .)	Penetrating Power. ($\frac{1}{a}$)
	Air ($n = 1.00$.)	Water ($n = 1.33$.)	Homogeneous Immersion ($n = 1.52$.)	White Light. ($\lambda = 0.5269 \mu$, Line E.)	Monochromatic (Blue) Light. ($\lambda = 0.4861 \mu$, Line F.)	Photography. ($\lambda = 0.4000 \mu$, Near Line h.)		
1.52	..	..	180° 0'	146,543	158,845	193,037	2.310	.658
1.51	..	..	166° 51'	145,579	157,800	191,767	2.280	.662
1.50	..	..	161° 23'	144,615	156,755	190,497	2.250	.667
1.49	..	..	157° 12'	143,651	155,710	189,227	2.220	.671
1.48	..	..	153° 39'	142,687	154,665	187,957	2.190	.676
1.47	..	..	150° 32'	141,723	153,620	186,687	2.161	.680
1.46	..	..	147° 42'	140,759	152,575	185,417	2.132	.685
1.45	..	..	145° 6'	139,795	151,530	184,147	2.103	.690
1.44	..	..	142° 39'	138,830	150,485	182,877	2.074	.694
1.43	..	..	140° 22'	137,866	149,440	181,607	2.045	.694
1.42	..	..	138° 12'	136,902	148,395	180,337	2.016	.709
1.41	..	..	136° 8'	135,938	147,350	179,067	1.988	.709
1.40	..	..	134° 10'	134,974	146,305	177,797	1.960	.714
1.39	..	..	132° 16'	134,010	145,260	176,527	1.932	.719
1.38	..	..	130° 26'	133,046	144,215	175,257	1.904	.725
1.37	..	..	128° 40'	132,082	143,170	173,987	1.877	.729
1.36	..	..	126° 58'	131,118	142,125	172,717	1.850	.735
1.35	..	..	125° 18'	130,154	141,080	171,447	1.823	.741
1.34	..	..	123° 40'	129,189	140,035	170,177	1.796	.746
1.33	..	180° 0'	122° 6'	128,225	138,989	168,907	1.769	.752
1.32	..	165° 56'	120° 33'	127,261	137,944	167,637	1.742	.758
1.30	..	155° 38'	117° 35'	125,333	135,854	165,097	1.690	.769
1.28	..	148° 42'	114° 44'	123,405	133,764	162,557	1.638	.781
1.26	..	142° 39'	111° 59'	121,477	131,674	160,017	1.588	.794
1.24	..	137° 36'	109° 20'	119,548	129,584	157,477	1.538	.806
1.22	..	133° 4'	106° 45'	117,620	127,494	154,937	1.488	.820
1.20	..	128° 55'	104° 15'	115,692	125,404	152,397	1.440	.833
1.18	..	125° 3'	101° 50'	113,764	123,314	149,857	1.392	.847
1.16	..	121° 26'	99° 29'	111,835	121,224	147,317	1.346	.862
1.14	..	118° 0'	97° 11'	109,907	119,134	144,777	1.300	.877
1.12	..	114° 44'	94° 55'	107,979	117,044	142,237	1.254	.893
1.10	..	111° 36'	92° 43'	106,051	114,954	139,698	1.210	.909
1.08	..	108° 36'	90° 34'	104,123	112,864	137,158	1.166	.926
1.06	..	105° 42'	88° 27'	102,195	110,774	134,618	1.124	.943
1.04	..	102° 53'	86° 21'	100,266	108,684	132,078	1.082	.962
1.02	..	100° 10'	84° 18'	98,338	106,593	129,538	1.040	.980
1.00	180° 0'	97° 31'	82° 17'	96,410	104,503	126,998	1.000	1.000
0.98	157° 2'	94° 56'	80° 17'	94,482	102,413	124,458	.960	1.020
0.96	147° 29'	92° 24'	78° 20'	92,554	100,323	121,918	.922	1.042
0.94	140° 6'	89° 56'	76° 24'	90,625	98,223	119,378	.884	1.064
0.92	133° 51'	87° 32'	74° 30'	88,697	96,143	116,838	.846	1.087
0.90	128° 19'	85° 10'	72° 36'	86,769	94,053	114,298	.810	1.111
0.88	123° 17'	82° 51'	70° 44'	84,841	91,963	111,758	.774	1.136
0.86	118° 38'	80° 34'	68° 54'	82,913	89,873	109,218	.740	1.163
0.84	114° 17'	78° 20'	67° 6'	80,984	87,783	106,678	.706	1.190
0.82	110° 10'	76° 8'	65° 18'	79,056	85,693	104,138	.672	1.220
0.80	106° 16'	73° 58'	63° 31'	77,128	83,603	101,598	.640	1.250
0.78	102° 31'	71° 49'	61° 45'	75,200	81,513	99,058	.608	1.282
0.76	98° 56'	69° 42'	60° 0'	73,272	79,423	96,518	.578	1.316
0.74	95° 28'	67° 37'	58° 16'	71,343	77,333	93,979	.548	1.351
0.72	92° 6'	65° 32'	56° 32'	69,415	75,242	91,439	.518	1.389
0.70	88° 51'	63° 31'	54° 50'	67,487	73,152	88,899	.490	1.429
0.68	85° 41'	61° 30'	53° 9'	65,559	71,062	86,359	.462	1.471
0.66	82° 36'	59° 30'	51° 28'	63,631	68,972	83,819	.436	1.515
0.64	79° 36'	57° 31'	49° 48'	61,702	66,882	81,279	.410	1.562
0.62	76° 38'	55° 34'	48° 9'	59,774	64,792	78,739	.384	1.613
0.60	73° 44'	53° 38'	46° 30'	57,846	62,702	76,199	.360	1.667
0.58	70° 54'	51° 42'	44° 51'	55,918	60,612	73,659	.336	1.724
0.56	68° 6'	49° 48'	43° 14'	53,990	58,522	71,119	.314	1.786
0.54	65° 22'	47° 54'	41° 37'	52,061	56,432	68,579	.292	1.852
0.52	62° 40'	46° 2'	40° 0'	50,133	54,342	66,039	.270	1.923
0.50	60° 0'	44° 10'	38° 24'	48,205	52,252	63,499	.250	2.000
0.45	53° 30'	39° 33'	34° 27'	43,385	47,026	57,149	.203	2.222
0.40	47° 9'	35° 0'	30° 31'	38,564	41,801	50,799	.160	2.500
0.35	40° 58'	30° 30'	26° 38'	33,744	36,576	44,449	.123	2.857
0.30	34° 56'	26° 4'	22° 46'	28,923	31,351	38,099	.090	3.333
0.25	28° 58'	21° 40'	18° 56'	24,103	26,126	31,749	.063	4.000
0.20	23° 4'	17° 18'	15° 7'	19,282	20,901	25,400	.040	5.000
0.15	17° 14'	12° 53'	11° 19'	14,462	15,676	19,050	.023	6.667
0.10	11° 29'	8° 38'	7° 34'	9,641	10,450	12,700	.010	10.000
0.05	5° 44'	4° 18'	3° 46'	4,821	5,252	6,350	.003	20.000

COMPARISON OF THE FAHRENHEIT AND CENTIGRADE THERMOMETERS.

Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.
212	100	158	70	104	40	50	10	- 4	- 20
210.2	99	156.2	69	102.2	39	48.2	9	- 5.8	- 21
210	98.89	156	68.89	102	38.89	48	8.89	- 6	- 21.11
208.4	98	154.4	68	100.4	38	46.4	8	- 7.6	- 22
208	97.78	154	67.78	100	37.78	46	7.78	- 8	- 22.22
206.6	97	152.6	67	98.6	37	44.6	7	- 9.4	- 23
206	96.67	152	66.67	98	36.67	44	6.67	- 10	- 23.33
204.8	96	150.8	66	96.8	36	42.8	6	- 11.2	- 24
204	95.56	150	65.56	96	35.56	42	5.56	- 12	- 24.44
203	95	149	65	95	35	41	5	- 13	- 25
202	94.44	148	64.44	94	34.44	40	4.44	- 14	- 25.56
201.2	94	147.2	64	93.2	34	39.2	4	- 14.8	- 26
200	93.33	146	63.33	92	33.33	38	3.33	- 16	- 26.67
199.4	93	145.4	63	91.4	33	37.4	3	- 16.6	- 27
198	92.22	144	62.22	90	32.22	36	2.22	- 18	- 27.78
197.6	92	143.6	62	89.6	32	35.6	2	- 18.4	- 28
196	91.11	142	61.11	88	31.11	34	1.11	- 20	- 28.89
195.8	91	141.8	61	87.8	31	33.8	1	- 20.2	- 29
194	90	140	60	86	30	32	0	- 22	- 30
192.2	89	138.2	59	84.2	29	30.2	- 1	- 23.8	- 31
192	88.89	138	58.89	84	28.89	30	- 1.11	- 24	- 31.11
190.4	88	136.4	58	82.4	28	28.4	- 2	- 25.6	- 32
190	87.78	136	57.78	82	27.78	28	- 2.22	- 26	- 32.22
188.6	87	134.6	57	80.6	27	26.6	- 3	- 27.4	- 33
188	86.67	134	56.67	80	26.67	26	- 3.33	- 28	- 33.33
186.8	86	132.8	56	78.8	26	24.8	- 4	- 29.2	- 34
186	85.56	132	55.56	78	25.56	24	- 4.44	- 30	- 34.44
185	85	131	55	77	25	23	- 5	- 31	- 35
184	84.44	130	54.44	76	24.44	22	- 5.56	- 32	- 35.56
183.2	84	129.2	54	75.2	24	21.2	- 6	- 32.8	- 36
182	83.33	128	53.33	74	23.33	20	- 6.67	- 34	- 36.67
181.4	83	127.4	53	73.4	23	19.4	- 7	- 34.6	- 37
180	82.22	126	52.22	72	22.22	18	- 7.78	- 36	- 37.78
179.6	82	125.6	52	71.6	22	17.6	- 8	- 36.4	- 38
178	81.11	124	51.11	70	21.11	16	- 8.89	- 38	- 38.89
177.8	81	123.8	51	69.8	21	15.8	- 9	- 38.2	- 39
176	80	122	50	68.2	20	14	- 10	- 40	- 40
174.2	79	120.2	49	66	19	12.2	- 11	- 41.80	- 41
174	78.89	120	48.89	66.4	18.89	12	- 11.11	- 42	- 41.11
172.4	78	118.4	48	64	18	10.4	- 12	- 43.60	- 42
172	77.78	118	47.78	64.6	17.78	10	- 12.22	- 44	- 42.22
170.6	77	116.6	47	62	17	8.6	- 13	- 45.40	- 43
170	76.67	116	46.67	62.8	16.67	8	- 13.33	- 46	- 43.33
168.8	76	114.8	46	60	16	6.8	- 14	- 47.20	- 44
168	75.56	114	45.56	60	15.56	6	- 14.44	- 48	- 44.44
167	75	113	45	59	15	5	- 15	- 49	- 45
166	74.44	112	44.44	58	14.44	4	- 15.56	- 50	- 45.56
165.2	74	111.2	44	57.2	14	3.2	- 16	- 50.80	- 46
164	73.33	110	43.33	56	13.33	2	- 16.67	- 52	- 46.67
163.4	73	109.4	43	55.4	13	1.4	- 17	- 52.60	- 47
162	72.22	108	42.22	54	12.22	0	- 17.78	- 54	- 47.78
161.6	72	107.6	42	53.6	12	- 0.4	- 18	- 54.40	- 48
160	71.11	106	41.11	52	11.11	- 2	- 18.89	- 56	- 48.89
159.8	71	105.8	41	51.8	11	- 2.2	- 19	- 56.20	- 49
								- 58	- 50



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MEETINGS FOR 1892-3, at 8 p.m.

Wednesday, OCTOBER .. 19, 1892.	Wednesday, FEBRUARY 15, 1893.
" NOVEMBER 16, "	" MARCH .. 15, "
" " 30, "	" APRIL .. 19, "
(Conversazione at St. James's Hall Restaurant.)	" MAY 17, "
" DECEMBER 21, "	" JUNE .. 21, "
" JANUARY .. 18, 1893.	
(Annual Meeting for Election of Council and Officers.)	

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JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.

AUGUST 1892.

TRANSACTIONS OF THE SOCIETY.

IX.—*Note on the Process of Oviposition as observed in a Species of Cattle Tick.*

By R. T. LEWIS, F.R.M.S.

(Read 18th May, 1892.)

PLATE VII.

DURING the past six months I have occasionally received from a correspondent in Natal a number of specimens of the Tick family, together with such information as he has been able to gather concerning their habits of life, his main object being to elicit such further information as might be of use in indicating the most probable direction in which some satisfactory means of dealing with this serious pest might be found. From his reports it would appear that the injury

EXPLANATION OF PLATE VII.

The eight figures given represent the anterior extremity of the tick during the process of oviposition, from a point of view directly in front of and slightly above the marginal line—scale $\times 14$ —image erect. The arched portion at the top of each figure is the margin of the inflexible dorsal plate, below which is the depression produced by the retraction of the head*—the palpi and rostrum alone being visible. Surrounding this depression on its three other sides are the parts drawn over from the softer ventral surface by the same action. The first pair of legs are seen—one on either side—extended in an upward direction, the ovipositor is below and between them.

- Fig. 1 shows the parts referred to, at the commencement of the process.
,, 2, the first appearance of the membranous sac above the head, the ovipositor extending, and the palpi separating.
,, 3, the same, further developed.
,, 4, the position of the parts immediately prior to the extrusion of the egg.
,, 5, the same, immediately after.
,, 6, the membranous body enveloping the egg.
,, 7, " " " being withdrawn.
,, 8, the removal of the egg by the palpi.

* The word "head" here and throughout the paper is used in its ordinary and popular signification. As pointed out by Mr. Michael at the meeting (see p. 447) in *Ixodes* there is no true head, the part usually so designated being in reality the *rostrum*, a term often restricted to the projecting portion made up of the maxillary lip and the sheaths containing the mandibles.—R. T. L.

inflicted by these creatures upon domestic animals, especially horses and cattle, can hardly be overstated, and a microscopic examination of the structure of their mouth-organs leaves no doubt as to their natural capabilities for producing all the mischief laid to their charge. That they are often found in immense numbers upon ill-tended animals is a fact well known to stock-keepers in warm climates: but, although much has been done in the investigation of their minute structure, there still remain some missing links in their life-history, one of which it is hoped to supply by the following note.

All observers are agreed that when full grown and full fed the adult female tick voluntarily quits the animal upon whose blood it has been subsisting, and dropping off upon the ground, makes its way at once to the grass, amongst which it lays innumerable eggs, and dies. In favourable weather the eggs are said to hatch in about a fortnight, but what becomes of the young larvæ, or how they contrive to exist until opportunity arises for attaching themselves to some passing animal, is one of the points which remains to be cleared up; certain it is, however, that their habit is to ascend the grass-stalks in large numbers, there to await a passing chance of transference, and persons who walk amongst grass at the season when they most abound are sure to return with lively remembrances.

Early in November last I received by post a small consignment of various Cape insects, and inclosed with them was a cattle tick of larger size than any I had hitherto seen, its length on arrival being rather over $\frac{3}{4}$ in., and its weight 25 grains. My correspondent stated that it was not of a kind usually found in the interior of the colony, but that it had been taken from an ox recently brought up from the coast; it was sent off on October 13th, at which time it was said to have weighed 40 grains, though then much less distended than when captured about thirty-six hours previously. It had apparently beguiled the tedium of the voyage by laying a quantity of eggs; but, though torpid when unpacked, the warmth of the room soon revived it, and within an hour it was walking about the table, using, however, three pairs of legs only for the purposes of locomotion, and continually waving the first pair in the air in the same manner as an insect does its antennæ. It has not been easy to determine with certainty to what species this specimen belonged; size and colour, both being variable to a remarkable extent in the same individual under different conditions, cannot be greatly relied upon; but a comparison with such descriptions and figures as have been available leads to the conclusion that it is probably *Amblyomma coronatum*, the more common species, which nearly equals it in size, having been identified with *Amblyomma Hebræum* of Koch. Having been carefully examined, weighed and sketched, this tick was placed in a glass-covered box, where it remained for several weeks in a state of inactivity, except at times, when for purposes of exhibition it was taken in the hand or warmed by the fire; but early in December I noticed that the anterior portion of the ventral surface

had changed in colour from the original chocolate to a dark purple, and on the following morning about fifty eggs were found agglomerated in a heap in front of its head,* with several adherent to the margin of the hard dorsal plate, which appears to represent the upper portion of the cephalothorax in Spiders. These eggs—which were of a deep brown colour, bluntly oval, and measuring $\cdot 6$ mm. long by $\cdot 45$ mm. broad—were transferred to a glass tube in the hope that they would in due course hatch. The tick being replaced in the box repeated the proceeding two days later, the eggs being, as before, heaped in front of the head, but this time connected to the dorsal plate by a continuous chain adherent to it and to each other. It seemed clear that some such observation in the case of the Dog Tick—*Ixodes Ricinus*—had originally led Chabrier to form the erroneous opinion that the eggs were laid through the mouth, with the minute structure of which he was apparently unacquainted. The observations of Frisch on the same subject, though nearer the truth, were scarcely more conclusive—his assertion being that in laying her eggs the female gives out a clear fluid from her mouth for fixing the eggs to her body, for which purpose she advances them to her mouth when laid—because special precaution previously taken enabled me to say with certainty that the creature had not changed its position during the process in the slightest degree. A few evenings later, whilst examining the tick with a view to clear up the point, I noticed again the change of colour before mentioned, and hoping that it might portend a repetition of the proceedings, I placed it in an upright position in such a way that I could observe it under the Microscope with a low power. The head was much retracted, and I perceived for the first time that a deep cavity was formed between the upper side of the head and the under surface of the dorsal plate, the bottom of which seemed to be filled with mucous matter kept in a state of disturbance as if by the movement of something beneath its surface. Unfortunately the creature by some means overbalanced, and falling from the cell upon the table, abruptly terminated the observation. The next evening I specially contrived a cell to meet the requirements of the case, by means of which the tick was not only safely supported on end without fear of dislodgment, but could also be rotated without vibration whilst under the Microscope; nothing else was observed that night, but on the following morning about thirty eggs were found to have been laid, most of which were adhering to the front margin of the dorsal plate.

Disappointment at having again been foiled acted, however, only as an incentive to increased vigilance, and being determined to see the process, if anyhow possible, it was resolved to keep the tick under continuous observation throughout the next day, and night, if needful. It was therefore placed in the rotating cell with the light and warmth of a paraffin lamp converged upon it by a bull's-eye condenser in such

* See note following the "Explanation of Plate."

a way that it could be freely examined in the large field of a Kellner eye-piece through a tripod Microscope placed over it and fitted with a 3-in. objective.

During the somewhat tedious watch, which commenced at 8·30 a.m. on December 15th, I was relieved at intervals by my daughter, whose scientific training and skill as an observer rendered her on this occasion a valuable assistant. For many hours nothing of importance was noted beyond occasional alterations in the position of the front legs and palpi, of which sketches were made as required. But about 5 p.m. some very distinct changes began to take place; the head, which had all along been much retracted, was now so much further withdrawn that the extended rostrum and palpi retreated considerably within the marginal line, and in thus producing the deep depression in which the head was now nearly buried, the cavity between the head and the dorsal plate was again formed, whilst the softer adjacent portions of the lateral and ventral aspects were drawn inwards until that part which had previously been on the ventral surface between the basal joints of the first pair of legs was so far drawn over the margin as to point in an upward direction, when the creature was standing in its natural position. Whilst this was going on, the parts surrounding this depression underwent marked changes of colour, passing from brown to blue, and ultimately fading to a dull chrome-yellow, a well-marked white vesicle at the same time appearing upon the slightly elevated centre of the lower internal wall (fig. 1). About 6 p.m. the head was slowly lowered until the rostrum touched the under surface of the depression, the palpi being at the same time separated, so that one rested on each side of the white vesicle. This movement of course proportionately increased the width of the cavity between the head and the dorsal plate and enabled me again to see the motion I had observed on the previous night. In a few moments it was obvious that a delicate membranous body, glistening with mucus, was being protruded from the cavity (fig. 2), and at length, by a series of convulsive movements it was developed first as a mobile sac, from the lateral extremities of which two elevations were thrown up (fig. 3), in turn to be lengthened by evagination into two processes or papillæ which extended downwards more than half-way across the depression, the whole forming a kind of open receptacle something like that of the two hands of a person when placed together with the wrists in contact for the purpose of catching a ball (fig. 4). At the same instant the before-mentioned vesicle became elongated until it met and was embraced on either side by the papillæ; through its semitransparent walls an egg was seen in motion, which having been delivered into the grasp of the papillæ (fig. 5), the ovipositor at once retracted. This done, the papillæ closed over the new laid egg (fig. 6), and by a series of movements which can best be likened to the actions of the hands during the process of washing with a ball of soap, rapidly covered it with a coating of albuminous secretion, and

then withdrew (fig. 7) from sight, leaving the egg suspended by one end from the under surface of the dorsal plate. The palpi came next into operation, slowly closing together until in lineal contact with the rostrum, the elevation of the head brought their spoon-like terminal joints into contact with the egg, a continuance of the motion effectively cleared it out of the depression (fig. 8), left it adhering to the outer margin, and the process was complete. The head was then again depressed, the palpi resumed their former position and the series of operations which I have attempted to describe were exactly repeated, each successive egg displacing but adhering to the one which preceded it until a chain was formed, and ultimately on reaching the ground a heap resulted such as I had so often seen and puzzled over. The procedure once established went on uninterruptedly, giving us ample time to make careful notes and sketches, and to call in other witness of a series of rhythmical movements which at last seemed to fascinate the attention in the same way as is sometimes experienced by watching the cycles of a complicated piece of automatic machinery. The mean of many observations showed that the entire process of laying each egg occupied a period of 2 minutes 42 seconds, but after watching with great interest for upwards of 2 hours, during which we saw about 50 eggs laid without the least hitch—in one case only excepted—the accumulated pile began so far to obstruct the view that I ventured to remove it by lightly touching with a needle. The result of this interference was the immediate cessation of the process, in the course of a few minutes the normal colour of the parts was restored, the head was again protruded, and from that time to the day of its death about two months later not another egg was laid. Whatever may be the precise nature of the fluid with which the eggs were coated, it appears to possess the property of retaining its viscosity for a long time without becoming hardened by exposure to the air, so that eggs put into a tube readily become agglomerated into a ball by contact with each other, yet so lightly that the mass falls easily to pieces if lifted with the forceps, but as easily re-forms on being once more shaken together. Its possible use may be to afford additional protection from the heavy rains common in the regions where ticks do most abound, the slight cohesion affording but little obstruction to the escape of larvæ hatched out from the middle of the mass. The eggs themselves are not easily injured by pressure, having very tough elastic envelopes which explode with a smart crack when thrown upon the fire. I did my best to hatch out those laid by the tick which forms the subject of these observations, but though kept at an even temperature by being carried in the pocket for three months they all eventually flattened and collapsed, from which I concluded that they must have been unfertilized. On repeating the experiment with a quantity of similar eggs laid by the more commonly known "Great Cattle Tick," identified by Mr. Bairstow as *Amblyomma Hebræum*, and coming from the same district, I succeeded in hatching out a

brood to be numbered by thousands. These have afforded an unlimited supply of extremely interesting microscopic objects, but it is perhaps needless to say that every precaution has been taken to guard against the escape of those not required for mounting.

It has been remarked by my friend that if an overgorged tick drops of its own accord from a horse upon the dusty road it at once makes direct for the grass, leaving a characteristic and well-marked track at right angles to the roadside; but if on the other hand a tick is forcibly removed from the animal and thrown upon the road, it goes by a straight line back to him again. Eyes being mostly absent, a query arises by what sense is it so unerringly directed. In 1881 it was observed by Dr. G. Haller, "that near the hind margin of the terminal joint of the first pair of feet in *Ixodes Ricinus* there are two foramina which are covered by a transparent membrane, within which are found chitinous hairs and otoliths, presenting an extraordinary resemblance to the auditory arrangements of the Crustacea."* An organ similar to this, but furnished with a ring of external sensory hairs, is found likewise situated on the front legs of these cattle ticks, being quite distinct even in their earliest stage as soon as hatched, but I have observed that whereas in the larval condition, when possessed of six legs, all are used for purposes of locomotion, when the adult stage is reached and an additional pair of legs is acquired, the second, third, and fourth pairs only are employed in walking, the first pair being entirely withdrawn from the ground by the altered shape of the anterior portion of the body, and thenceforth kept in constant movement waving to and fro above and in front of the head as if they had taken upon themselves the functions of antennæ. The existence of a pair of sensory organs on the terminal joints of the palpi is more obvious, and is seen in the figures of most writers on the subject.†

* This Journal, 1881, p. 449.

† For observations confirming those recorded in this communication, see the Report of the Proceedings of the Society at the June Meeting (*postea*, p. 574).

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Theory of Germinal Layers and the Parablast.‡—M. F. Houssay, who has been investigating the formation of the circulatory system of the Axolotl, calls attention to a comparison that it is possible to institute between the different products of the ectoderm and endoderm.

Ectoderm	{	<i>Epiblast</i>	{1. The mesoblast; canal of the pronephros. 2. The parablast; lateral blood-vessel. 3. The metablast; openings of the branchial clefts.
	{	<i>Neuroblast</i>	
	{	Plus three contacts with	
Endoderm	{	<i>Mesoblast</i> with an axial portion	.. .. . Notochord.
	{	<i>Parablast</i>	.. .. . Subnotochord.
	{	<i>Protohypoblast</i>	{ <i>Metablast</i> Metachord <i>Hypoblast.</i> (rudimentary).
	{	<i>Deutohypoblast</i>	

The metablast appears to the author to be characteristic, more than any other peculiarity, of Vertebrates (inclusive of *Balanoglossus*). The first stage of the parablast is segmented; it arises from the protohypoblast by plates.

M. Houssay completely rejects the mesoderm as indicating a third layer. Comparably to the ectoderm and endoderm, it has no more value than the parablast, metablast, or neuroblast. If, he says, you speak of three layers, why not of six? He enunciates the general law that the point of origin of all the systems of organs of even complicated

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, &c., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, and Reproduction, and allied subjects.

‡ Comptes Rendus, cxiv. (1892) pp. 1128-30.

organisms is the result of a growth of their surface, without fresh increase in size; this causes involutions of the surfaces.

Fuller details are promised in a more extended memoir.

The Yolk-organ of Vertebrata.*—Dr. Hs. Virchow discusses the yolk-organ of Reptiles and of Amphibia in comparison with that of Birds. In reptiles the appendages to the wall of the yolk-sac develop as richly as in birds, but relatively late; the primary circulation is homologous; as regards the secondary arrangement of the vessels there are differences between the orders of reptiles as well as between reptiles and birds; in both classes the yolk-sac is taken up into the body-cavity; it seems likely, though not certain, that the vitelline duct in reptiles completely closes and disappears; Giacomini has described in *Seps chalcides* an allantoic-placenta at the proximal pole and a yolk-sac placenta at the distal pole—the latter, perhaps, comparable to a structure described by Duval in the bird. As the result of his comparison, Virchow concludes that reptiles are, as concerns yolk-sac, in no wise less differentiated than birds. But a study of the development of the “yolk-entoblast” leads him to believe that the yolk-organ of reptiles is essentially nearer that of amphibians. The nearer relationship rests on two facts—in the formation of typical large “yolk-cells” and in the occurrence of a yolk-segmentation. His description of the polymorphic yolk entoblast of reptiles is necessarily complicated. The epithelial “lecithoderm” containing cells with and without yolk is distinguished from the free cells which are not disposed in an epithelium. The free cells include (a) merocytes, rich or poor in protoplasm; (b) typical large yolk-cells, spherical or flattened; (c) cells without yolk, both round and flat; and (d) very small cells without yolk. These diverse elements the author describes, comparing what is seen in reptiles with what is seen in Selachians, Amphibians, and Birds.

Fertilization of Reptilian Ova.†—Dr. A. Ooppel, in investigating the early stages in the development of *Anguis fragilis* and *Tropidonotus natrix*, finds in the germinal disc several sperm-nuclei which occur under small pits on the disc. At the end of the first division of the oosperm-nucleus the accessory sperm-nuclei are still present, and some of them undergo division in an irregular fashion. Their presence seems to be due to polyspermy, and as they occur also in *Lacerta viridis*, it seems as if this were common in Reptilian ova. Even in the stage with sixteen segmentation-nuclei the persistence and the division of the accessory nuclei may be observed, but they take no share in forming the embryo.

Gastrulation in the Tortoise.‡—Herr L. Will has studied embryos of *Testudo lutaria*, and while confirming what Clark observed in regard to gastrula-invagination, has made several discoveries. The archenteron is remarkably large. The “sickle” and the primitive plate arising therefrom lie originally outside the embryonic shield. All the endoderm, including the sickle, arises not from a proliferation of ectoderm, but from the inclosure of segmentation elements which were already *in loco*.

* Zeitschr. f. Wiss. Zool., liii. Suppl. (1892) pp. 161-206 (1 pl.).

† Arch. f. Mikr. Anat., xxxix. (1892) pp. 215-90 (4 pls.). Anat. Anzeig., vi. (1891) pp. 536-44 (4 figs.).

‡ Biol. Centralbl., xii. (1892) pp. 182-92 (4 figs.).

Before invagination the endoderm becomes differentiated into a primary or archenteric, and a secondary or vitelline layer. The prostomial mesoderm arises by a splitting of endoderm. Although at first outside, the sickle and the primitive plate subsequently grow into the shield. In the tortoise the endoderm is separated as a continuous layer from the yolk; in the gecko the elements are separated singly, and afterwards form a layer. The archenteron is hollow throughout its whole extent, and its extent is absolutely and relatively greater than in the gecko.

Vertebral Column of Triton.*—Prof. C. Hasse demonstrates in *Triton tæniatus* the metamerism of the skeletogenous tissue, and the fundamental importance of the *elastica externa* in the formation of the vertebral column. The tailed Amphibians have not only an *elastica externa* or *cuticula skeleti* and an *elastica interna* or *cuticula chordæ*, but between these a sheath, arising from the skeletogenous tissue and not from the chorda, which forms the intervertebral cartilage of other authors.

Development of Connective Tissue in Siredon.†—Dr. F. Maurer distinguishes, according to their genesis, three groups of connective tissue—dorsal, intermediary, and ventral. The *dorsal* connective tissue arises from the protovertebræ, and may be divided into median and lateral portions. The dorso-median connective tissue is laid down in the sclerotome-diverticulum (axial-connective tissue of Rabl). The dorso-lateral connective tissue arises from the cutis-layer (dermal connective tissue of Rabl). The *intermediary* connective tissue is separated off from that region where the somatopleure and the splanchnopleure of the lateral plates bend into one another, and is associated mesially with the dorso-median tissue. The *ventral* connective tissue arises from the parietal plates (visceral connective tissue of Rabl), and may be divided into a median portion arising from the splanchnopleure, and a lateral portion arising from the somatopleure. The detailed results of Maurer's investigation go to justify this classification.

Embryology of the Sea-Bass.‡—Dr. H. V. Wilson has studied the development of *Serranus atrarius*, the Sea-Bass. The pelagic ovum is about 1 mm. in diameter, the membrane is thin and horny, the yolk a translucent sphere, with a single large oil-globule uppermost in the floating egg. In the ripe unfertilized egg the yolk is covered by a thin layer of protoplasm. Shortly after fertilization this concentrates towards a point just opposite the oil-globule. A couple of hours after fertilization there is found at the lower pole of the floating egg a disc of protoplasm lenticular in section, thinning away into a very delicate layer around the yolk. The yolk itself is without any protoplasm except near the oil-drop, which has a cap of coarse protoplasm. The patch or blastodisc at the lower pole is at first circular, but by the time the first two blastomeres are marked off the germ is bilateral or biradial. The segmentation, which is of the ordinary bilateral type characteristic of Teleostei, is described with great clearness. Careful observation suggests

* Zeitschr. f. Wiss. Zool., liii. Suppl. (1892) pp. 1-20 (3 pls.).

† Morphol. Jahrb., xviii. (1892) pp. 327-48 (1 pl.)

‡ Bull. U.S. Fish Commission, ix. (1891) pp. 209-77 (12 figs., 20 pls.). See *ante*, p. 188.

that "the symmetrical arrangement of cells in the blastoderm is the mere outward expression of a physiological bilaterality which already exerts control over the life of the organism."

The periblast nuclei arise in *Serranus* as Agassiz and Whitman have described in *Ctenolabrus*, viz. from the marginal cells of the blastodisc. During the formation of the periblast the superficial layer of the blastodisc becomes differentiated as the *Deckschicht* or "epidermic stratum," which is gradually flattened into a thin membrane. The blastodisc undergoes a change of shape preparatory to the invagination. The appearance of the sub-germinal cavity (a late phase of the segmentation cavity) between the blastoderm and the periblast, the formation of the *Randwulst*, the process of ingrowing, the significant centrifugal delamination in the *Randwulst*, are then described.

After the germ-ring is completed the growth of the blastoderm round the yolk is much more rapid than in earlier stages. The embryonic shield in the region of the posterior pole becomes sharply marked off. The ectoderm of the shield forms a thickened plate passing at the edge into the thin ectoderm of the non-embryonic area. Over the greater part of the shield the primary hypoblast consists of two distinct strata of flattened cells. An interlocking in the middle line is the first step in the formation of the notochord. The thickening of ectoderm to form the neural cord, beginning in the future head region; the development of the notochord and secondary layers; and the formation of the primitive streak and closure of the blastopore are fully described.

After a careful study, Mr. Wilson feels safe in saying that the lateral sheets of endoderm grow under the chorda cells and meet in the middle line, thus completing the layer. At the time of the closure of the blastopore (29 hours) the mesoblast consists of two thick lateral masses thinning away at the sides, but not exhibiting the two-layered arrangement which in the trout prefigures the differentiation into somatopleure and splanchnopleure. In opposition to Hertwig, Wilson agrees with other students of Teleostean development in maintaining that the mesoderm arises by delamination.

The alimentary canal is formed from the simple endoderm lamella by a process of folding along the median line. The fold is converted into a tube by the meeting of its lower edges. There is a solid postanal gut formed as a thickening of the endoderm lamella, not as a fold. At the end of the postanal gut is Kupffer's vesicle which is formed in essentially the same way as the permanent gut. Kupffer's vesicle and the entire postanal gut atrophy. In the interpretation of Kupffer's vesicle, Wilson substantially agrees with J. T. Cunningham—it is the terminal part of the archenteron.

Passing over the description of the development of neural chord, surface ectoderm, eye, &c., we may emphasize the interest of Wilson's observation that one ectodermic *Anlage* gives rise to the ear, a functional branchial sense-organ, and the organs of the lateral line. This is not to be regarded as of phylogenetic significance, but as a convenient method of forming these organs, which the embryos of certain animals have adopted. The fact serves, however, to emphasize in a striking way the homology between the organs. In many respects Wilson here corroborates Beard's conclusions.

After describing the origin of mesodermic structures—somites, heart, and the like—Dr. Wilson concludes his important memoir with a discussion of general morphological questions. The theory of His, that the vertebrate embryo is formed by the conrescence of two halves along the median dorsal line, receives no confirmation in the development of the Bass. Ziegler's interpretation of Teleostean gastrulation is corroborated, and in regard to the significance of the germ-ring with respect to the amniotic gastrula, the author comes back to the Balfour-Rauber hypothesis.

Polyspermy in Selachian Ova.*—Dr. J. Rückert has come to the conclusion that most, if not all, of the merocyte nuclei (vitelline or parablast nuclei) in the ova of Selachians are modified male pronuclei. They are present before the fusion of pronuclei; they resemble male pronuclei in structure; their appearance is preceded by the occurrence of several spermatozoon-heads; transitions between them and spermatozoa were observed. From a study of the nuclear elements, Rückert infers that all merocyte nuclei of the early stages of segmentation which possess a reduced number of chromosomata result from spermatozoa. This is true of most, and perhaps all, of the merocyte-nuclei which originally occur in the germinal disc. The possibility is not excluded that some may result from migratory maternal cells, but this has not been proved. What Oppel has observed in Reptilian ova confirms Rückert's conclusions.

Ovarian Ova of Selachii.†—Prof. J. Rückert has studied these in *Pristiurus*, *Scyllium*, and *Torpedo*, especially in the first-named. The germinal vesicle of the smallest ova has several nucleoli and numerous isolated chromosomata, forming what looks like a coil. It is very difficult to count these chromosomata, but there seem to be about 30–36, as there are in the mitosis of somatic cells in *Pristiurus*.

As the *first developmental period* Rückert defines that which lasts until the ova have a diameter of about 1.5–2 mm. The germinal vesicle steadily increases in size, the nuclear membrane is distinct, the nucleoli increase in number. Each chromosoma is bordered by fine threads, as if outgrowths of the microsomata. Towards the end of the period the chromosomata become disposed in pairs, and their number is doubled, probably by longitudinal division.

The *second developmental period* lasts from the time that the germinal vesicle has its maximum size until its dissolution (in ova 14–16 mm. in diameter). The chromosomata are shortened and thinned; their microsomata pass through a series of retrogressive changes; the pairs of chromosomata become more closely intertwined; the whole mass is reduced. It can hardly be a "*Keimplasma*" which undergoes such alterations of mass, it must be an involved somatic plasma. The nucleoli are also reduced in mass; they seem to have some functional relation to the metabolism of the chromosomata.

The *third developmental period* includes the disappearance of the germinal vesicle and the formation of the polar bodies. The chromatin elements, though not to be exactly counted, number only about a fourth

* Anat. Anzeig., vii. (1892) pp. 320–33 (2 figs.).

† Tom. cit., pp. 107–58 (6 figs.).

of the previous single chromosomata, or about a half of the double chromosomata. The author believes in the continuity of the chromosomata and in a cohesion of those previously distinct, a cohesion during which there is an interchange of material. He believes in a mutual fertilization—an amphimixis—of chromosomata, “a hypothesis not unwarranted in the present state of our knowledge.”

Development of the Lamprey.*—Dr. Ph. Owsjannikow publishes some of the results of his prolonged study of the lamprey's development. The germinal vesicle in the very young ova with semi-fluid contents is often excentric. The Graafian follicles are invested by endothelial cells; the blood-vessels enter at the pointed end of the follicle, within which lies the active pole of the ovum. The length of development varies with the temperature; at 16° Réaumur the larvæ hatched in nine or ten days. The first two planes of segmentation are longitudinal, the third is equatorial. The segmentation and gastrulation are described. The endoderm is formed by the separation of a row of cells from the yolk. The nerve-cord is at first solid, but subsequently exhibits a canal. Anteriorly the notochord arises as a double fold from the endoderm, and in other regions by a simple constriction. Unlike Shipley, the author does not find that the Wolffian ducts arise before the proto-vertebræ. As regards the origin of the sense-organs, previous observations are confirmed. As to the heart, Shipley's conclusions are in the main accepted. The endocardium arises in close association with the myocardium, and Goette erred in referring it to endoderm. In contradiction to Kupffer, Owsjannikow maintains that a neurenteric canal is distinctly demonstrable. Concerning the nervous system, it is noted that the hypophysis originates from ectoderm; that all ganglia—both cranial and spinal—have an independent ectodermic origin; that the spinal ganglia persist for some time with ectodermic connections, though not yet united with the spinal cord, by the sides of which they lie.

B. Histology.

Origin and Development of Muscular Tissue.†—Prof. G. H. T. Eimer is of opinion that there can be no doubt that the cross-striation of the highly developed musculature of Insects is only the expression of a temporary physiological condition. This cross-striation may disappear, reappear, and take on very various forms; although, from an early stage, it exhibits a definite segmentation. At first, as in the adductor muscles of Lamellibranchs, it is only transitory, and of the simplest character, without intermediate discs. In other cases it is constant. This incomplete cross-striation is seen in muscles that are comparatively inactive, and especially in lower animals, though also in Arthropods. The higher development of the cross-striation, when there are intermediate discs—the complete cross-striation—may be simple or compound. It is the latter, when the middle disc is divided into two or more. The alternation of a transverse and an intermediate disc is the ground-form of complete cross-striation. This ground-form is, in the

* *Mélanges Biol.* (Bull. Acad. Imp. St. Petersb.) xiii. (1891) pp. 55-67.

† *Zeitschr. f. Wiss. Zool.*, liii. Suppl. (1892) pp. 67-111 (13 figs.).

author's opinion, the mechanical result of contraction. It is the expression of the fact that in very active muscles stronger and weaker waves follow one another alternately. Everything tends to confirm the view of Kölliker that the alternation of darker and clearer parts is due to differences in the aggregation of the parts of one and the same mass; this mass must have the nature of a viscous fluid. The author is opposed to the view that the intermediate discs are comparatively firmly fixed partitions.

It appears that the contractions of the plasma constantly take place in a definite direction, and the peculiar property of the muscular mass consists in this, that the contractions of a body or of its parts are effected in definite directions. It is undoubted that from the primitively homogeneous foundation from which muscular and connective tissue are developed in multicellular animals, muscular tissue is developed along the lines in which especially active contraction is effected, while connective tissue becomes developed in the non-active parts. Muscular masses almost always first appear in the outer layer of active parts; in unicellular animals it is formed from the outer plasmatic layer of the body; in multicellular forms it appears first in the dermo-muscular layer. These and other facts show that mechanical work is the cause of the form taken by the tissue. Each muscular filament is to be regarded as a column of the muscular mass which has become what it is in consequence of continued contractions in a direction perpendicular to its primitive surface. Cross-striation is the expression of constant waves in the muscular mass formed under nervous influence.

Present State of the Doctrine of Cell-division.*—Dr. R. Zander sums up, in a very useful way, the present state of the doctrine of cell-division. Advances have no doubt been made, but the author points out that we are still far from being able to make a final judgment. A bibliography of 94 papers is appended.

Leucoblasts and Erythroblasts.†—Prof. M. Löwit pursues his researches on the two kinds of hæmatopoetic elements—leucoblasts and erythroblasts—which he distinguishes in blood-forming organs. His present inquiry concerns the arrangement and formation of these elements in the organs. He has succeeded in technically differentiating the two kinds by the use of platinum chloride. The erythroblasts are distinguished by their nuclein or chromatin; the leucoblasts by their nucleolin or pyrenin.

He first describes the fixed cells in the blood-forming organs. These are connective-tissue cells and elements of endothelial or epithelial character. Löwit finds no support for the view that the leucocytes arise from the mitosis of endothelial cells. He then describes the erythroblasts, the colourless elements which give rise to red blood-corpuscles. They occur in lymph-glands, spleen, medulla, single and grouped follicles of the intestine, and in the embryonic liver. They always exhibit the same definite nuclear peculiarities which the author describes at length. They multiply exclusively by mitosis, and do not arise from fixed tissue-elements. On the contrary they are distinct from the

* Biol. Centralbl., xii. (1892) pp. 281-309.

† Arch. f. Mikr. Anat., xxxviii. (1891) pp. 524-612 (3 pls.).

embryo onwards; and the organs in which they occur abundantly are simply localized areas of multiplication.

The leucoblasts, on the other hand, do not appear to multiply by mitosis; what has been described as such is the mitosis of fixed cells or of erythroblasts. They persist from embryonic life onwards, multiplying by amitosis in special localities, but never arising from fixed cells. Prof. Löwit then describes in detail the precise disposition of the erythroblasts and leucoblasts in the various organs involved.

According to Löwit the red blood-corpuscles arise (as long as they continue nucleated) from the mitosis of other erythrocytes and eventually from the colourless erythroblasts, and the blood-forming organs mentioned are the special areas for this multiplication. Similarly, the white blood-corpuscles arise in the hæmatopoetic organs from leucoblasts, quite distinct from erythroblasts. Multiplying by amitosis, they pass by the lymph or venous blood into the general circulation as mononuclear leucocytes, or they may be modified into polynuclear elements—a degenerative rather than a regenerative change.

Structure of Nerve-fibres.*—Dr. Ph. Owsjannikow corroborates what has been observed by M. Joseph and Jakimowitsch, that the axial cylinder may exhibit a distinct transverse striation like that of striped muscle. He has observed this in the frog, rat, &c., and in the non-medullated nerves of the crayfish. In the lamprey, however, it was distinctly seen that the striation occurs only on the outer surface of the axis-cylinder, and does not affect the primitive fibrils. Owsjannikow emphasizes the fact that treatment of nerve-fibres with silver alters them greatly, and gives origin to artificial structures. The primitive fibrils are more distinct in the lamprey than in other animals: they exhibit varicosities, and are separated by an intermediate substance. The Ewald-Kühne network is a normal, certainly not an artificial, structure.

Muscle-spindles.†—Herr A. A. Christomanos and E. Strössner discuss the various opinions held in regard to muscle-spindles. They describe their characters in Man, in embryonic, adolescent, and adult subjects. Against the supposition that they are due to physiologically atrophied muscle-bundles, many considerations are adduced, while other facts seem to show that the spindles are actively concerned in the growth and development of the muscle-fibres.

Relation of Animal Protoplasm to Hæmoglobin.‡—Herr Gürber emphatically denies the conclusion of A. Schwartz that it is a general property of animal protoplasm to form and to destroy hæmoglobin. The results of experiments with the cells of liver and spleen do not tally with those of Schwartz. A solution of hæmoglobin is indeed decolorized and re-coloured by spleen and liver cells, but that is explained as follows. The hæmoglobin is changed for the most part into met-hæmoglobin and is taken up by the cell-masses in the same way as by charcoal. To act thus, the "Zellbrei" produced from spleen cells is naturally suited; that produced from liver cells only does so after the addition of water. When putrefaction alters the physical nature of the

* *Mélanges Biol. (Bull. Acad. Imp. Sci. St. Petersb.)* xiii. (1891) pp. 101-12.

† *SB. K. Akad. Wiss. Wien, c.* (1891) pp. 417-35 (3 pls.).

‡ *SB. Phys.-med. Gesell. Würzburg* (1891) pp. 114-22.

cell-mass, the cells break up into fine débris and the slightly coloured and probably less soluble met-hæmoglobin is converted by reducing substances into the more strongly coloured and more soluble oxy-hæmoglobin, and the pigment reappears in the fluid.

γ. General.

Inheritance of Mutilations.*—Herr K. Knauthe has collected nine cases in which dogs whose tails or ears, or both, had been cut in their youth, bore young curtailed as in the mother. The details are given.

Fauna of Jamaica.†—Mr. E. A. Andrews gives a general sketch of the fauna of Jamaica. *Amphioxus* in young stages was taken, but no adults could be found. Goose-barnacles grow to a length of one inch, in two weeks. *Peripatus* seems to be excessively rare, and was not found by the author or his party. No leeches were found. An interesting addition is a peculiarly marked new species of *Balanoglossus*, with alternating half-rings of red across the body, and of large size. No pelagic Polychætes were found. Many species of *Chiton* are abundant, and the pulmonates are of large size. Tunicates are excessively numerous, except *Salpæ* which were neither seen nor heard of. Several large Ctenophores abound in Kingston Harbour, especially in June and July.

Homology.‡—Taking as his text numerical variation in teeth, Mr. W. Bateson discusses the conception of Homology. He points out that the received view supposes that a varying form is derived from the normal, much as a man might make a wax model of the variety from a wax model of the type, by small additions to and subtractions from the several parts. But the natural process differs in one great essential from this; in Nature the body of the varying form has never been the body of its parent, and is not formed by a plastic operation from it. In each case the body of the offspring is made again from the beginning, just as if the wax model had gone back into the melting-pot before the new model was begun.

Case of Mimetism between an animal and an alga.§—Signor A. Piccone has met with several instances in which a specimen described as a *Valonia (utricularis or ægagropila)* is in reality a mass composed of the egg-capsules of a marine mollusc, probably a species of *Buccinum*, simulating not only the form of the frond of the alga with its ramifications, but even its proliferation. A careful examination reveals, however, the presence, in every capsule, of a minute orifice, through which the young escape. A microchemical examination, also, of the membrane leaves no doubt as to its animal character.

B. INVERTEBRATA.

Physiology of Invertebrata.||—Dr. A. B. Griffiths, whose contributions to the physiology of the Invertebrata we have from time to time

* Zool. Anzeig., xv. (1892) p. 5.

† John Hopkins Univ. Circ., x (1892) pp. 72-7.

‡ Proc. Zool. Soc. Lond. (1892) pp. 102-15.

§ Malpighia, v. (1892) pp. 429-30.

|| 'The Physiology of the Invertebrata,' by A. B. Griffiths, London, 1892, Svo, ix. and 477 pp., 80 figs. in text.

noticed, has published a text-book on the subject. An account is given of some of the most important researches on the subject published during the last fifteen or twenty years. It would be possible to point to passages which might have been otherwise expressed, and subjects which might with advantage have been differently treated, but as it is the first work of its kind in our language, we may be thankful for what it gives us.

Mollusca.

Malacological Fauna of the Red Sea.*—Dr. Jousseume considers that the Red Sea has been supplied with animals from the Indian Ocean, of which it is merely a big bay. The wealth of Indo-Pacific forms in the Red Sea does not surprise him, as he always considered currents to be the most active cause in the distribution of Mollusca.

Cleavage of Ovum of *Crepidula fornicata*.†—Mr. E. G. Conklin describes the eggs of *Crepidula* as being laid in pouches and fixed under the shelter of the shell; here they are aerated by currents of water, which are swept into and out of the branchial chamber. The author corrects his earlier account of the relation of the axes of the embryo; he finds that the "cross furrow" always bends to the right when the first furrow is in the line of vision, and to the left when the second furrow is in that position. It was found that the first furrow is transverse to the long axis of the embryo, and divides the egg into an anterior and a posterior half, while the second furrow lies in the long axis, and divides the egg into right and left halves. Each of the four macromeres formed by the first two cleavages contains the elements of both ectoderm and endoderm, but only the left posterior macromere contains mesoderm. Four characteristically arranged ectoderm cells occupy the centre of the ectodermic area, and when thirty-six ectoderm cells have been formed these four central cells form the centre of a cross of ectoderm cells. In further development all the arms of the cross lengthen, and all save the posterior divide longitudinally into two parallel rows of cells. An elongated blastopore is formed on the ventral side, it closes posteriorly more rapidly than anteriorly, but at last it leaves only a small depression, where the mouth is finally formed.

γ. Gastropoda.

Movements of *Lymnæus* on the Surface of Water.‡—Gräfin M. von Linden has studied these familiar movements. It is not the case that the concave foot forms a boat which supports the snail, for the foot may be quite flat while the animal moves rapidly. Moreover the snail may swim a few millimetres below the surface. The fact is that the animal is able to alter its specific gravity as it pleases. On one gliding along the surface an air-bubble may be seen at the respiratory aperture; as this bubble recedes or protrudes, the snail sinks or rises. If the bubble be removed or lost, the snail sinks, and before it can swim again it must reach the surface by creeping. The actual movement is due to undulatory contractions of the sole. It is especially for the sake of food

* Ann. Sci. Nat., xii. (1892) pp. 343-63.

† Zool. Anzeig., xv. (1892) pp. 185-8 (5 figs.).

‡ Biol. Centralbl., xi. (1891) pp. 763-6.

that the animals glide along the surface. In capturing small leaves, &c., the foot is often very dexterously used. Besides aquatic plants and small animals, the snails sometimes find larger booty, e. g. the larvæ of Mayflies.

Nervous System of *Nerita polita*.*—M. L. Boutan finds that *Nerita polita* (and *Navicella porcellana*) present a crossing of the commissures, such as is seen in other Aspidobranchs. The right branch is represented by an extremely delicate nerve. The gill is innervated both by the first right ganglion and the first left ganglion of the asymmetrical centre. The nerve-cords in the foot are solely formed by the pedal ganglia, which have the otcysts on their hinder part. The inferior lobe of the mantle is directly innervated by the first two ganglia of the asymmetrical centre. M. Boutan is led, therefore, to conclude that the Neritidæ are chiastoneurous and not orthoneurous, as stated by M. Bouvier.

M. E. L. Bouvier,† referring to M. Boutan's communication, states that he has discovered in *Nerita plexa* a supra-intestinal nerve-branch which had before escaped him. Having examined several allied forms he is now inclined to think that all these orthoneuroid Prosobranchs are really chiastoneurous. It is clear that the Neritidæ and Helicinidæ are allied to the other diotocard Prosobranchs, and the idea that there are two divergent series of Prosobranchs must be altogether given up. The facts adduced by the author seem to destroy the chief argument of those who do not consider that the crossing of the nervous system is the consequence of the displacement of the anus.

Anatomy of West Indian *Helices*.‡—Mr. H. A. Pilsby finds that the genital system of *Caracolus* is simple, while that of *Hemitrochus* is complicated by a large dart-sac, and several unequal accessory glands; there is a long flagellum of the "whiplash" type, while that of *Caracolus* is short.

Two rare British Nudibranchs.§—Mr. F. W. Gamble gives fresh descriptions of *Lomanotus genei*, and *Hancockia eudactylota*; a single specimen of each species was obtained by him in Plymouth Sound. Cnidocysts were carefully looked for in the former, but were not detected. *Govia viridis* Trinchese is a synonym of the latter. The dorsal papillæ of *Lomanotus* respond to stimuli, but those of *Hancockia* do not.

Zoological Position of *Solenococoncha*.||—Dr. L. Plate has investigated the zoological position of *Dentalium* and its allies; and concludes that the eight following points are indications of a closer affinity to the Gastropoda than to the Lamellibranchiata: the unpaired shell, the radula, the jaws, the tentacles, the retractor-muscles which appear to be homologous with the columellar, the presence of pleural ganglia, which are rarely seen in Lamellibranchs, the extreme development of the buccal ganglia, and the possession of œsophageal glands which seem to correspond to the salivary glands of Gastropods. Grobben's view that

* Comptes Rendus, cxiv. (1892) pp. 1133-5.

† Tom. cit., pp. 1281-3.

‡ Proc. Acad. Nat. Sci. Philad., 1892, pp. 128-9 (1 pl.).

§ Ann. and Mag. Nat. Hist., ix. (1892) pp. 378-85 (1 pl.).

|| Verhandl. Deutsch. Zool. Ges., 1891, p. 60. See Amer. Nat., xxvi. (1892) pp. 347-8.

1892.

the *Dentalia* are representatives of ancestral forms might be accepted if the arms of the Cephalopoda can be shown to be the homologues of the tentacles of *Dentalium*, but it seems to Dr. Plate more probable that they are pedal in nature. Prof. Grobben urged in reply that the radula and pleural ganglia were probably possessed by the ancestor of the Lamellibranchiata, and had, therefore, no weight, while the arguments as to the pedal nature of the tentacles of Cephalopods were not conclusive. Prof. Leuckart assigned a position between the Gastropoda and Lamellibranchiata to the Solenoconcha.

Molluscoida.

a. Tunicata.

Eyes and Subneural Gland in *Salpa*.*—Mr. M. M. Metcalf has a preliminary note on the results of his studies on *Salpa*. The eye of *Salpa pinnata*, solitary form, in every part faces toward the mid-dorsal point of the brain; the retina is composed of three layers of cells. These are the pigment cells, equal in size to the unmodified nerve-cells; a layer of cells which closely resembles the nerve-cells, and a layer of rod-cells. In a young embryo a dorsal ridge of cells becomes developed from the ganglion, and has, from the first, the characteristic horse-shoe shape. The ridge increases in size as the ganglion grows. When the central cells of the ganglion degenerate, the cells in the core of the ridge degenerate also. The retinal cells do not begin to assume their characteristic appearance till some time later. The most peripheral layer of cells over the portion of the ridge which is destined to form the retina become larger, and then columnar. The adult condition is reached by an increase in the size of the rod-cells, a greater thickening of the walls of their inner ends, and by a greater deposit of pigment granules in the posterior cells of the retina.

The eye of *Salpa pinnata*, chain-form, agrees in structure with that of the solitary, but its shape is quite different; in addition to the median dorsal eye there are also two pairs of much smaller eyes. One pair is placed on either side of the middle point of the posterior face of the brain, while the other pair lies on the dorsal surface, one on each side. While the eyes of solitary forms of various species show a close agreement with those of *S. pinnata*, those of the chain form show very marked differences in the different species; differences which are constant and characteristic, and which Mr. Metcalf believes to have great value in a systematic study of the group. The early stages of the development of the eye of the chain-form of *S. pinnata* are almost the same as those of the solitary forms. The smaller eyes develop later than the larger eye, and are formed by the histological differentiation of certain of the ganglion cells situated in the positions where the smaller eyes are found in the adult.

The *Salpæ* differ from the *Ascidia* in having the cavity of the central nervous system, which is present only in early stages, continuous with the lumen of the ciliated funnel. In an early stage of the chain-form, long before any trace of the eye appears, the cavity of the brain, and the lumen of the funnel (or "dorsal tubercle") open into each other by

* John Hopkins Univ. Circ., xi. (1892) pp. 78-9.

a duct which is so short and wide as hardly to deserve the name duct. There is no histological distinction between funnel, duct, and brain. Later on, the duct becomes a small round tube, and the brain becomes much flattened dorsoventrally. Canals for a short time ramify through the tissue of the brain, but the tissue soon becomes solid. There is evidence that the early function of the ciliated funnel and its duct is the aeration of the brain, while the waste products of the brain-cells may have been passed away by them. The later condition of the ciliated funnel indicates that it is very probably a sense organ which serves to test the quality of the water entering the pharynx.

Periodic Regeneration of Upper Half of Body in Diplosomidæ.*—

Mr. A. Oka states that there is a new species of *Diplosoma*, found on the Japanese coast, in which the upper half of the body is periodically renewed; the species, which may be called *D. Mitsukurii*, is most nearly allied to *D. chamæleon*. When the separate members of a colony are examined, each is seen to possess two branchial sacs, and two peribranchial sacs of different ages. In short, the whole upper half of each individual is double. In stained sections it is clear that the older half has begun to degenerate. In some cases the oesophagus is trifid, and in this case one branch extends to the outer layer of the ectoderm, and ends blindly, while the branchial sac has completely disappeared. The younger half-individual is usually bent to one side, and only gradually takes on an upright position, while the older becomes crumpled up and finally obliterated, even the scar formed by it on the ectoderm disappearing. From a lateral bud a third half individual is soon developed, which goes through the history of the second, which follows the fate of the first.

Dolchinia mirabilis.†—Under this name Prof. A. de Korotneff describes a remarkable new Tunicate from Naples; it is allied to *Anchinia* and *Doliolum*. There is a colonial tube to which the zooids are loosely attached; they are arranged pretty regularly; on either side of the groove which extends along the upper part of the tube there lie the youngest zooids, and the size of these increases with their distance from the groove. The lower surface of the tube has no zooids. With regard to budding it is suggested that the following may be the phylogenetic series—(1) Buds arising from the proliferous stolon produce a nurse only which cares for the sexual form—*Dolchinia*. (2) Buds produce two different nurses, one of the colony (lateral form) and one of the sexual form—*Doliolum*. (3) Buds produce two different nurses, but the sexual form, or, rather, its germ does not become planted on its nurse, but fixes itself directly on the colonial tube, the other form is rudimentary—*Anchinia*. (4) Buds produce only a nurse which cares for the colonial or lateral form, and there is no sexual nurse—Hypothetical form. A more extreme reduction would be a simple alternation of generations, asexual and sexual, with an abolition of the sterile form. The asexual form of *Dolchinia* is not known, but we may suppose that it has a proliferating stolon, and a tail like *Doliolum*; it is probably of large size and has a heavy and very long tail.

* Biol. Centralbl., xii. (1892) pp. 265-8 (1 fig.).

† Mittheil. Zool. Stat. Neapel, x. (1891) pp. 189-205 (2 pls.).

Arthropoda.

a. Insecta.

Histolysis and Histogenesis of Muscular Tissue in the Metamorphosis of Insects.*—Prof. A. Korotneff, bearing in mind the work of preceding investigators, asks the following questions. As the definite muscle-nuclei are directly descended from the nuclei of the larval muscles, what is the definite part played by the mesenchyme-cells and their nuclei in the formation of the muscles of the imago? Where do the muscle-fibres arise, and in what way? The plasmatic cords which, according to Van Rees, must take part therein, are very doubtful and quite special structures. How do the other muscles of the body arise? If as Kowalevsky states, then the plasmatic cords are quite unnecessary structures, and the development of the other muscles of the imago is solely due to the mesenchyme-cells. But this double origin of muscles in one form seems scarcely probable.

The author's own observations have been confined to *Tinea*, where he finds that the following are the chief points in the metamorphosis. There are no special mesenchyme-cells in the larva; the coelom contains only leucocytes and granule-spheres. The leucocytes take absolutely no part in the degeneration of the tissues. The formation of all the imaginal muscles is to be regarded as a re-formation of the larval muscles. In the thorax some muscles disappear, and only the three pairs mentioned by Van Rees are transformed into the definite thoracic musculature of the Moth.

The resorption of the muscles is effected in the following way; the fibrillar portion becomes granular and draws itself together; the nuclei multiply chiefly on one side of the muscle.

The altered muscle consists at last of a fibrous and a granular part which run parallel to one another, at the same time the primitive bundle is resorbed, and without the leucocytes taking any part in it. The nuclear cord soon separates from the muscle, and begins to move off from the surface; it soon produces new fibrils, which, at first, are hardly to be distinguished; later on, the fibrils have the form of rhomboidal structures, which are imbedded in the plasma of the nuclear cord between the nuclei. In a longitudinal section the earlier, atrophied, and the newly developed muscles form two parallel bands, and possess two distinct tendons. In an advanced pupa of *Tinea*, no signs of the larval muscles are to be detected, for after becoming gradually smaller, they have finally been resorbed. Instead of them there are to be seen, in transverse sections, well-marked spots which stain deeply with hæmatoxylin, and are an expression of the nuclear cords in which the muscle-fibrils were laid down. In the further development of the definite muscles the muscle-fibrils collect into bundles, which, in cross-section, are seen to be fringed with muscle-nuclei.

This mode of metamorphosis of muscle appears, from a theoretical standpoint, to be logical and quite intelligible; and the author's observations are quite in keeping with the pathological phenomena sometimes seen in the muscles of higher animals.

Lower Senses of Insects.†—Dr. W. Nagel points out that the dermal sensory organs of Insects, which are hairs, cones, and porous plates or

* Biol. Centralbl., xii. (1892) pp. 261-5 (5 figs.).

† 'Die niederen Sinne der Insekten,' Tübingen, 1892, 8vo, 68 pp., 1 pl.

structures intermediate between these, always have a wall, and that there is free nerve-ending on the surface of the body. When these organs have a thick chitinous wall they can only serve for the perception of mechanical stimuli; when they are thin-walled they are adapted for mechanical, thermal, and chemical stimuli. The thin-walled hair-like structures are most important as olfactory and gustatory organs. The sense of equilibrium, and in many cases that of hearing, has no specific sensory organ among Insects, but many and various dermal sensory organs combine to effect their purpose. The value of the several senses to the animal varies among Insects, and there is a corresponding variation in the development of the several sense-organs.

Variation in Colour of Cocoons.*—Mr. W. Bateson has tested the view of Poulton that the variation in the colour of the cocoons of *Eriogaster lanestris* and *Saturnia Caspini*, which are sometimes dark brown and sometimes much lighter, is due to the colour of the substances to which they are attached. He finds that light-coloured cocoons are produced when the larvæ are confined in either white or dark substances, but that when left with their food the cocoons are dark. As many of the larvæ evacuate a brown substance, and as there is good evidence that a brown meconial fluid is voided by caterpillars which are removed and shut up before they spin, it is suggested that the cocoons of the secluded larvæ are white by reason of the previous voiding of the brown fluid and the consequent absence of a supply of colouring matter.

Effects of Artificial Temperature on Coloration of Species of Lepidoptera.†—Mr. F. Merrifield has confirmed, with *Selenia illunaria* and *S. lunaria*, the results attained to with *S. illustraria* and *Ennomos autumnaria*; the imagines are materially influenced in their colouring by the exposure of the pupa in its penultimate stage to a moderate difference of temperature; the limits being 57° F. and 80° F., it is found that the lower causes the greater darkness of colour. Markings are very materially affected by exposure to a temperature of about 33° F.

Scale-like and Flattened Hairs in Lepidopterous Larvæ.‡—Prof. A. S. Packard calls attention to the scale-like hairs found in the larvæ of *Gastropacha quercifolia* and *G. americana*, in *Clistocampa proxima* and various Noctuidæ. They appear to be of use in making the dorsal tufts more conspicuous, and they are interesting as examples of the acceleration of development of the setæ in the larval stage.

Venation of the Wings in Lepidoptera.§—Dr. A. Spuler describes what he believes to be the fundamental type of venation. It represents a stage through which all Lepidoptera have passed, and it is congruent with what occurs in Neuroptera, Panorpatæ, Trichoptera, and Diptera. In Neuroptera, Trichoptera, Panorpatæ, and two families of Lepidoptera, the plan is the same for anterior and posterior wings, in most Lepidoptera a reduction of the venation has occurred in the hind pair. Owing to the difficulties of description and nomenclature without illustrative figures we cannot do more than notice Spuler's general result. He compares the venation of Lepidoptera with that in related orders, takes due account of ontogenetic corroborations, and considers several families of Lepidoptera in detail.

* Trans. Entomol. Soc. London, 1892, pp. 45-52. † Tom. cit., pp. 33-44.

‡ Ann. and Mag. Nat. Hist., ix. (1892) pp. 372-5 (1 fig.).

§ Zeitschr. f. Wiss. Zool., liii. (1892) pp. 597-646 (2 pls.).

Mimicry among Papilionidæ.*—Dr. E. Haase continues the publication of his treatise on this subject. So far he has been clearing the way, and even in the present part the mimetic adaptations of Hemiptera, Hymenoptera, Neuroptera, and Coleoptera are cited at length. Reaching the Lepidoptera, he first discusses the doubtful cases among Palæartic forms. Passing to Indo-Australian forms, he deals with the Danaidæ, Palæotropinæ, Acræinæ, Morphinæ, Pieridæ, Papilionidæ, which serve as models, and with the mimetically adapted Nymphalinæ, Satyrinæ, &c.

Aporia Cratægi.†—Dr. K. Eckstein describes this widely distributed Pierid, notable for its sudden and abundant appearance in districts from which it may have been absent for decennia. He notes its mode of flight among the flowers, and the differences between male and female, the latter being remarkable for the downward and forward bending of the anterior wings when at rest. The odour of *Aporia* is strong and repulsive to the human olfactory sense. On the wings pollen is abundantly collected, and its accumulation may make the insects fly heavily. The urine is remarkably red, and sometimes soils the wings. Eckstein also describes the eggs, caterpillars, and pupæ; the swarms of *Aporia* which appeared in 1889–90 in Eberswald afforded abundant material.

Development of Parasitic Hymenoptera.‡—Herr N. Kulagin has studied the development of *Platygaster*, *Mesochorus*, and *Microgaster*. In the two first-named forms there are no embryonic membranes; the embryos cast off the upper hypodermic layer. In *Microgaster* a small fold of the hypodermis represents a rudiment of the amnion, and the larva (within the caterpillar of *Pieris brassicæ*) grows without ecdysis. The mouth-parts of the larva of *Microgaster* are formed before the parasite emerges from its caterpillar host. They consist of a pair of mandibles and two pairs of one-jointed conical processes; the gut consists of a fine œsophagus, a large mid-gut, and a fine hind-gut; the tracheæ appear as integumentary invaginations. While the parasitic larval life lasts, the terminal segment appears like an expanded bladder—the protruded proctodæum; the Malpighian tubules open beside the anal aperture, and have no connection with the gut. Before pupation the larval skin of *Microgaster* is cast, and the terminal vesicular segment atrophies. The mouth-parts of the adult *Microgaster* are formed anew. The organs of the adult are formed from imaginal discs. In *Mesochorus splendidulus* the fully formed larva has nine segments; the first or head segment is larger and broader than the rest; the tail segment is prolonged into a process. The head bears two pairs of protrusions, and at the boundary of the thoracic segments there are appendages like the “clawed feet” of *Platygaster* and *Microgaster*. The larva grows, as in *Microgaster*, without ecdysis, and leaves its host before pupation. The summer generation pupates in willow-galls, without any cocoon. In winter *Mesochorus splendidulus* occurs in the larvæ of *Nematus Vallisnerii* and there pupates, and the larvæ of *Platygaster* occur in *Biorhiza terminalis*. A larva of *Platygaster* from the gut of Cecidomyidæ may live and develop in a pepsin solution. When there are several larvæ of

* Bibliotheca Zool. (Leuckart and Chun) viii. (1892) pp. 9–32 (10 pls. not published).

† Zool. Jahrb., vi. (1892) pp. 230–40.

‡ Zool. Anzeig., xv. (1892) pp. 85–7.

Mesochorus within *Nematus*, the development is usually incomplete, and the same is true of *Platygaster* larvæ within the larvæ of *Cecidomyiæ*.

Instinct of *Ammophila affinis*.*—Dr. P. Marchal has made many observations on the well-known habits of this sand-wasp which, like other Sphegidae, paralyzes its victims by stinging the ventral ganglia. He concludes (1) that the habit is not wholly disinterested; (2) that there are many gradations between the insect which kills and that which paralyzes its victims; (3) that the procedure is by no means stereotyped, but variable in details; (4) that the stinging of the ganglia is not necessary to secure paralysis, indeed the sting must, from the nature of the victim, be often effected between the ganglia. None the less, Dr. Marchal admits the wonder of the instinct, and suggests, as Mr. Darwin also did, how the inefficacy of stinging the sides of the victim might lead to the habit of stinging the median ventral line, and eventually the ganglia. Moreover, the median ventral line is often the most convenient and natural line of attack.

Classification of Sphegidae.†—General O. Radoszkowski has made a close study of the genital armature of these Hymenoptera, some of which have, while others have not, genital palps on the eighth segment of the abdomen. He urges that the classification based on the various characters of the genital apparatus is more natural than those founded on modifiable characters, and recognized as unsatisfactory by working entomologists.

Hymenoptera fossoria.‡—The sixth part of Herr A. Handlirsch's monograph of these Wasps deals with the genus *Stigus*, of which 143 species are fully diagnosed; of these 44 are new to science. The completeness of the author's work may be imagined from the fact that hitherto never more than sixteen species have been described in one work.

Roots of Alary Nerve of Coleoptera.§—M. A. Binet, without any physiological experiments and merely by observation of microscopical preparations, has made an investigation into the roots of the alary nerve in various Coleoptera. There are two roots, one dorsal and one ventral. In apteric Coleoptera, as the author calls such forms as those in which the fore-wings are not used in flight, the dorsal root has disappeared from the nerve which goes to the elytra, while the ventral root is retained. M. Binet considers, therefore, that the ventral root is sensory, and the dorsal region of the ganglion motor.

Male Generative Organs of Diptera.||—Mr. N. Cholodkovsky has made a study of the male organs of a few Diptera, and especially of *Laphria*. He finds that the wall of the testicular tube consists of a thin but firm nucleated membrane, below which there is a structureless *membrana propria*. Epithelium is only found at the point of passage of the seminal duct; this last, as well as the appended glands, has the same external membrane as the testis, while the *vas ejaculatorium* is surrounded by a thick, multilaminar membrane, which stains very

* Arch. Zool. Expér. et Gén., x. (1892) pp. 23-36.

† Bull. Soc. Imp. Nat. Moscou, 1891 (1892) pp. 571-96 (5 pls.).

‡ SB. Ak. Wiss. Wien, ci. (1892) pp. 25-204 (3 pls.).

§ Comptes Rendus, cxiv. (1892) pp. 1130-2.

|| Zool. Anzeig., xv. (1892) pp. 178-80.

feebly with carmine, and contains numerous nuclei. In the appended gland the cells of the epithelium are, in places, very high, and form a number of longitudinal ridges which project far into the lumen of the gland. The tracheæ which form a rich network around the testes do not extend into its cavity any more than in other Insects.

The spermatogenesis of *Laphria* is very peculiar, and recalls the process described by Verson for *Bombyx mori*. At the blind end of the testicular tube there is a colossal cell, visible to the naked eye, from which all the contents of the testes arise; in *Laphria* this stage is found in the imago. The huge cell gives off radial plasmatic outgrowths, in which numerous nuclei are imbedded; in the central mass there are always several large nuclei irregular and unequal in form. Nuclear division is not amitotic as in *Bombyx*, but typically mitotic.

Labial Palps of Hemiptera.*—Prof. N. Léon has been able to detect and photograph rudimentary three-jointed labial palps in Hemiptera, and therefore agrees with Gerstfeld's interpretation of the proboscis.

Termites †—Prof. B. Grassi sums up the results of his study of termites. From nests of *Calotermes flavicollis* and *Termes lucifugus* there swarm every year many completely winged individuals; in the first-named species some of these found new colonies, in the latter (in Sicily, at least) all are lost. The males usually swarm separately from the females—an obstacle to the pairing of closely related forms. A certain number of winged *Calotermes* in the course of swarming settle on the rotting trunks of trees. There, if not already bereft of wings, they get rid of them and begin to feed on the wood. The two sexes meet and pair, and each pair begins to found a new colony. The individuals which pair have shortened antennæ; no "royal" termite ever has entire wings. Termites communicate with one another by shaking the whole body, and the movement may be accompanied by a slight stridulation produced by rubbing the pronotum and the head together. The organ discovered by Fritz Müller on the tibia of termites is tympanal, and the insects seem to hear the noise of the above-mentioned shaking of the body. Termites feed on dead or rotten wood, on a pap of gnawed wood and salivary juice, on the fæces of other members of the colony, on their super-numerary fellows, or on the salivary secretions of some of their neighbours in the colony. They also drink water.

By altering the proportions and quality of the food, the development of individuals destined to become perfect insects is arrested or diverted. Thus arise the workers, the more differentiated soldiers, and the complementary kings and queens. The differences in the nutritions are stated. At the head of the colony of *Termes lucifugus* there are hundreds of complementary queens; the complementary males have a precarious existence. At the head of the colony of *Calotermes flavicollis* there is a royal pair once winged. If this pair be wanting, the colony provides a "substitutionary pair," or, more precisely, a number from whose fierce struggles a pair survive. After stating some other interesting observations, Prof. Grassi has a note on the Protozoa which are parasitic in Termites—*Monocercomonas termitis* sp. n., *Dinenympha gracilis* Leidy, of the family Cercomonadideæ; *Joenia annectens* g. et sp. n., *Trichonympha*

* Zool. Anzeig., xv. (1892) pp. 145-7 (1 fig.).

† Atti R. Accad. Lincei, i. (ser. v. 1892) pp. 33-6.

agilis Leidy, *Microjoenia hexamitoides* g. et sp. n., of the family Lophomonadidæ; *Pyrsonympha flagellata* sp. n., *Holomastigotes elongatum* g. et sp. n., of the family Pyrsonymphidæ.

Origin and Formation of Chitinous Investment of Larvæ of Libellulidæ.*—M. J. Chatin is of opinion that this chitinous covering is formed by the epidermic cells, not as a secretion, but by an altogether special process which compels us to consider the investment as directly formed by the protoplasm of the cells being transformed into chitinized layers. In this way plates are formed, the thickness of which increases progressively, and in which the trabecular structure of the hyaloplasm may be made out. As they extend to the neighbouring elements, these products of differentiation provoke their fusion and profoundly modify the texture of the epidermic or chitinogenous layer. M. Chatin thinks that the facts which he brings forward ought to modify the current ideas as to the mode of formation of the integument of Insects, which is generally looked on as a secretion which is at first liquid and hardens on contact with air. They are not without value as indicating the importance of the study of cuticular structures from the point of view of Zoological Histology.

3. Arachnida.

Hydrachnidæ.†—Prof. P. Kramer, in investigating the larval forms of Hydrachnidæ, has been led to divide the genera into three subdivisions. The first includes *Hydrachna*, the second the majority of fresh-water mites, the third *Diplodontus*, *Hydrodroma*, *Eylaïs*, and probably *Limnochares*. The last subdivision shows most affinities with Trombidiidæ.

Herr R. Piersig ‡ describes a minute new species of *Arrenurus*, which he names *A. bisulcicodulus*. Of Neuman's new genus *Bradybates* he has discovered a German species *B. truncatus*. A number of larval forms are also described.

Circulation of Blood in Young Spiders.§—M. M. Causard has examined the circulation in the young of fifteen genera of dipneumonous Araneida. His results differ in some points from those obtained by Claparède with *Lycosa*. The recurrent branch given off from the cephalic arteries conveys the blood into a lacuna which occupies the median part of the upper surface of the cephalothorax, and not, as he thought, into a true canal. In Spiders which have undergone their first moult and are still transparent, ramifications of the cephalic arteries may be noticed which were not observed by Claparède. The appearance of ramifications which do not exist immediately after birth is very interesting, as showing that the arterial system is capable of complication, and of attaining the development described by Blanchard and by Schneider. The blood which reaches the heart does not all pass by the lungs, but may circulate in the integument. The venous blood circulates in a very extensive system of lacunæ.

Sensory Structures of Solpugidæ.||—Dr. Ph. Bertkau describes peculiar sensory organs on the upper surface of the last joint of the palps and first pair of limbs in species of *Solpuga*, *Galeodes*, and *Datames*.

* Comptes Rendus, cxiv. (1892) pp. 1135-8.

† Zool. Anzeig., xv. (1892) p. 149.

§ Comptes Rendus, cxiv. (1892) pp. 1035-8.

|| Zool. Anzeig., xv. (1892) pp. 10-3 (1 fig.).

‡ Tom. cit., pp. 151-5 (3 figs.).

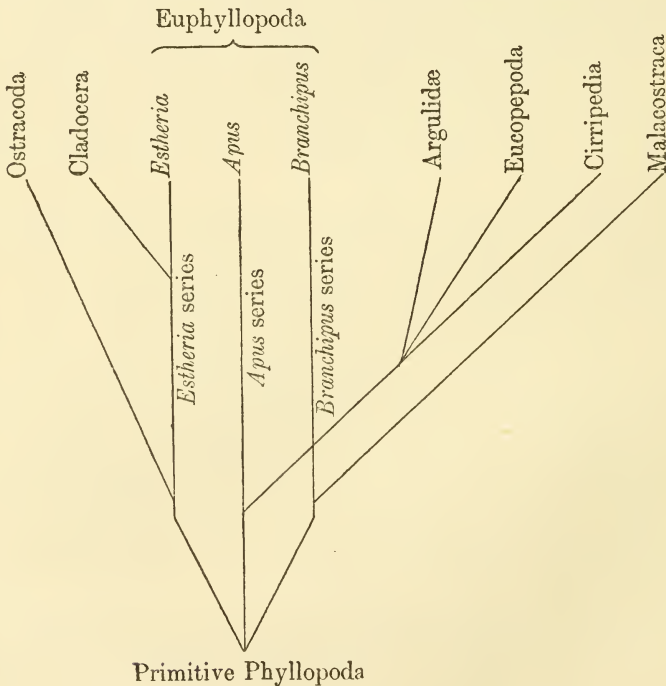
They are of two kinds, "champagne-cork-like" and "bottle-like," but may be referred to the same type. Their peculiarity is that between the chitinous terminal part and the ganglion-cell there is interpolated a glandular part. They are in all likelihood olfactory. In a subsequent paper † Bertkau notes that Gaubert has recently described the "bottle-shaped" organs in *Galeodes barbarus*.

Pentastomum denticulatum.‡—Herr St. v. Ratz found in the liver and lungs of a sickly sheep a large number of *Pentastoma*, which caused a considerable destruction of tissue, and gave rise to a catarrhal pneumonia. The parasites appeared to be migrating in a centrifugal manner.

ε. Crustacea.

Phylogeny and Classification of Crustacea.§—Prof. K. Grobben has attempted to refer not only the Entomostraca but also the Malacostraca to three types of existing Euphyllopoda—*Branchipus*, *Apus*, and *Estheria*. A comparison of the most essential characters of these forms shows that the Cladocera and Ostracoda may be referred to stem-forms resembling *Estheria*, the Copepods and Cirripedes may be related to an *Apus*-like stem-form, while the Malacostraca are to be referred to a stem-form of which the *Branchipus*-type is a remnant.

The author expresses his views in the following table :—



* Zool. Anzeig., xv. (1892) pp. 110-1.

† Veterinarius, 1890, No. 7. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 574-5

‡ SB. Ak. Wiss. Wien, ci. (1892) pp. 237-74.

He proposes to break up the present division of the Entomostraca into three sub-classes and to regard the present group of Malacostraca as a fourth sub-class; set out in systematic fashion Prof. Grobбен's classification is as follows:—

Class CRUSTACEA.

- I. Sub-class Phyllopoda.
 - 1. Order Euphyllopoda.
 - 2. „ Cladocera.
- II. Sub-class Estheriæformes.
 - Order Ostracoda.
- III. Sub-class Apodiformes.
 - 1. Order Copepoda.
 - 2. „ Cirripedia.
- IV. Sub-class Malacostraca (Branchipodiformes).
 - A. Leptostraca.
 - Order Nebaliidæ.
 - B. Eumalacostraca.
 - 1. Order Stomatopoda.
 - 2. „ Thoracostraca.
 - 3. „ Arthrostraca.

This classification is very similar to one suggested by the late Prof. Balfour.

Finally, with regard to the Malacostraca, the author propounds a phylogenetic table in which he derives the primitive Malacostraca from the primitive Phyllopoda; a side branch leads to the Leptostraca, while the trunk is continued into the primitive Schizopoda. The lowest side branch gives off the Stomatopoda, the next the Amphipoda, Isopoda, and Tanaida, the next Cumacea, and the next the Decapoda, while at the top of the main trunk there stands the group Schizopoda.

Protective Functions of Skin.*—Mr. W. B. Hardy has investigated the reason of *Daphnia* being such a “conspicuously clean Crustacean,” while *Cyclops* has a host of ectoparasites. He studied the ectoderm of *Daphnia* after treatment with methylen-blue; the animal was placed on a Microscope in a drop of normal salt solution, lightly coloured by the addition of a small quantity of the pigment. The preparation was then covered by a cover-glass, which was so supported by a few slips of moistened paper that it just touched the animal. On very lightly pressing the cover-glass with a mounted needle the brittle cuticle of the upper half of the shell is ruptured, and a crack 1/10 mm. long is made, by means of which the pigment slowly makes its way; a most beautiful differential staining occurs, the various histological elements coming into view one by one as the stain penetrates further and further from its point of entrance.

The cells of the ectoderm are seen to be, for the most part, thin and plate-like in character, and each corresponds in size and shape to a superjacent area of the pattern on the carapace. In addition to the flat cells there are others which are thicker, and bear processes which extend into the seta-like hairs which form a fringe to the free edges of

* Journal of Physiology, xiii. (1892) pp. 309–19.

the shells, and occur also on the appendages. Of the flat cells, each forms a thin plate closely adherent to the carapace, and in the centre of each there is a large rounded nucleus with one marked nucleolus. The cell-substance is coloured a transparent but distinct blue by the dye, and immersed in this matrix are a number of round vacuoles which are apparently occupied by fluid matter. These give the rose reaction with yellow light, which is in the body also given only by the basophil granules of the blood-corpuscles. These vacuoles may be the receptacles of solid particles which have, by some process, been ingested by the cells. The rose reaction is also seen in a substance of the nature of a slime which the *Daphnia* has the power of casting on to its surface. This substance has a strong affinity for the methylen-blue dye, and we may, under the Microscope, watch the formation of a film, sometimes of considerable thickness, over the entire surface of the Crustacean. It appears to be a true secretion of the ectoderm cells, for, as it forms, there is a distinct diminution in the intensity of the rose reaction of the ectoderm cells.

A parallel case has been observed by Miss Alcock and Dr. Gaskell in the Ammocoetes-stage of *Petromyzon Planeri*, where a slime is formed which contains an active proteolytic ferment capable of rapidly digesting fibrin in the presence of a small quantity of free hydrochloric acid. On the other hand, Mr. Hardy completely failed in demonstrating the existence of a slime on the shells of *Cyclops*.

There is a general similarity in the behaviour of ectoderm cells and blood cells towards microbes; both discharge a rose-staining substance previously stored in their cell-substance.

Durham has called attention to the slime formed by wandering cells in Echinoderms, and Mr. Hardy calls special attention to the fact that these cells are loaded with granules.

Two suggestions may be made as to the way in which the surface-slime of animals protects them. It may have a mechanical action; it may be taken for granted that the presence of a film of soluble slime on the surface of an animal immersed in water would, like the copper sheathing of ships, mechanically prevent the occurrence of parasitic growths by continually forming a fresh surface. The slime may, further, have a specific poisonous power, mainly, perhaps, against the more minute and subtle forms of vegetable parasites.

Embryology and Metamorphosis of *Macrura*.*—Prof. W. K. Brooks and Mr. F. H. Herrick have devoted much attention to a study of these higher Crustacea, the life-history of which is of exceptional value for the study of the laws of larval development. An account is first given of *Stenopus hispidus*, the larva of which is, at the time of its escape, a Protozoa, and it, later on, unites features of resemblance to *Lucifer*, *Sergestes*, *Peneus*, and the prawns in general. As in the Sergestidæ, the last two pairs of "walking legs" are shed after the Mysis-stage to be again constructed in the Mastigopus-stage.

A very remarkable account is given of the metamorphosis of *Alpheus*, for it has been discovered that "while there is such a general similarity as we might expect between the larval stages of the different species, the

* John Hopkins Univ. Circ., xi. (1892) pp. 65-71.

individuals of a single species sometimes differ more from each other, as regards their metamorphosis, than the individuals of two very distinct species." In the full memoir shortly to be published this phenomenon is carefully described in *A. heterochelis* and *A. Saulcyi*; in the case of the first of these the difference seems to be geographical, while in that of the second it is in direct relation to the conditions of life. The species live in the tubes and chambers of two species of Sponges, and the metamorphosis of those that live in one is quite different from that of those in the other. As Prof. Brooks remarks, this phenomenon is highly remarkable, and worthy the most thorough examination, for it is a surprising departure from one of the established laws of embryology—the law that the embryonic and larval stages of animals best exhibit their fundamental affinities and general resemblances, while their specific characteristics and individual peculiarities make their appearance later. It must, however, be borne in mind that the early stages of two closely related species may differ greatly; one may lead a free life, while the other is protected by the parent. Among Echinoderms we find marked differences between the complicated metamorphosis of the free larvæ and the history of those which are developed in brood-pouches. These considerations do not apply to the case of the two forms of the same species, as here described.

Considerable variations obtain in the habits and coloration of *Alpheus*; one species is found in green and in brown sponges, and it is suggested that the parasites of the green sponge were born in the brown variety, and after attaining considerable size, migrated to the green sponges, when they adapted themselves to their slightly different surroundings, growing to three or four times their former size, and the females acquiring bright green eggs, which become a source of protection in their new habitat.

From a study of the embryology of *Alpheus*, Mr. Herrick is brought to the conclusion that the germinal layers in the early stages of development have not the significance that is usually assigned to them. Development in general is characterized by great secondary modifications, and there is considerable retardation in the differentiation of the layers, and especially of the endoderm.

The Stomatopoda do not carry their eggs about with them, but deposit them in their deep and inaccessible burrows under the water, where they are aerated by the currents of water produced by the abdominal feet of their parents. Larval life is long, and thus the larvæ undergo secondary modifications, which have no reference to the life of the adult.

Decapod Crustacea of Kingston Harbour, Jamaica.*—Mr. J. E. Benedict gives a list of the thirty-eight Decapods collected in Kingston Harbour; among them is the representative of a new genus called *Areograpsus* (*A. jamaicensis* sp. n.) and of two new species—*Eucratoplax spinidentata* and *Sesarma bidentata*.

Larval Forms and Relationships of Cancridæ.†—Dr. G. Cano has studied the post-embryonic development of Cancridæ with the view of

* John Hopkins Univ. Circ., xi. (1892) p. 77.

† Bull. Soc. Entomol. Ital., xxiii. (1891) pp. 146-58 (2 pls.).

determining the relationships of the genera. The Xanthidæ (*Xantho-* and *Panopæus*) are higher forms than *Eriphia* and *Pilumnus*. This is especially shown by a comparison of the second pair of antennæ. Cano would separate *Cancer* and *Pirimela* in a sub-family Cancerinæ from two other sub-families Eriphinæ and Xanthinæ.

Hermaphroditism in the Crayfish.*—Prof. v. la Valette St. George describes in *Astacus fluviatilis* what he terms internal hermaphroditism. It seems as if certain spermatogonia, “untrue to their original destination,” may, instead of dividing into spermatocytes, grow into ova. The appearance at different months of the year is described, and the author takes occasion to discuss certain problems raised by the facts.

Entomostraca from Orkney.†—Mr. T. Scott has a few notes on some freshwater, brackish-water, and marine Ostracoda new to the fauna of Orkney; of the fresh- and brackish-water forms at least ten species were found, four of which are new to Orkney. Fifteen marine species appear to be new to the fauna, and it is probable that much more work could be profitably done there.

Free Freshwater Copepoda.‡—M. J. Richard has a somewhat elaborate monograph on these animals. He points out that we have not as yet had a complete knowledge of the test-gland of any Copepod, though it is found in all freshwater forms. Two parts can always be distinguished; there is a sac whose walls are lined by excreting cells, and there is a chitinous canal of varying length, which is completely enveloped by a granular protoplasm which contains a number of nuclei. In all forms where it has been followed to its termination this canal opens to the exterior on the upper and inner surface of the base of the first pair of maxillipeds. A complete account is given of the test-gland of *Diaptomus Castor*, and it is shown that the arrangements are the same in a number of other species. Though the canal may differ in disposition in various genera, it is always the same in the species of one genus, and its arrangement is a good generic character; similarity in points of detail are indications of zoological affinity. The canal is longest in species confined to fresh water, and shortest in those which live indifferently in fresh or salt water.

The function of the gland is the excretion of waste products, and these products are mainly found in the cavity of the gland in a state of solution; the organ is suspended in the blood fluid, and the glandular part is the active part, the canal serving merely as a duct. The antennary gland of Copepods corresponds to the organ of the same name in other Crustacea; to the test gland that of the Phyllopora, Cladocera, Argulidæ, and Leptostraca. The author does not admit the hypothesis of Hartog that the two glands were primitively one.

The just-named author's account of the salivary glands of *Cyclops viridis* is very incomplete; these organs are found in all Copepods; though they vary in number there is always a single median orifice on the labrum. The glands are unicellular, but often of great size, and are ordinarily filled with slightly refractive small vesicles. They empty their

* Arch. f. Mikr. Anat., xxxix. (1892) pp. 504-24 (1 pl.).

† Proc. and Trans. Nat. Hist. Soc. Glasgow, iii. (1892) pp. 91-100.

‡ Ann. Sci. Nat., xii. (1892) pp. 113-270 (4 pls.).

products into a small median dilatation, which is connected with the external orifice by a very short duct. It has not been shown that they play any part in the digestion of food.

The glands of the abdominal segments and of the joints of the legs are generally oval; each has, at its distal extremity, a single orifice which is situated under a small chitinous scale. These openings are always on the outer face of the joints. They are connected with nerve-filaments, and their contents appear to vary in character with the abundance of food.

In *Canthocamptus* the unicellular glands are very numerous and well developed. The abdominal segments are almost completely surmounted by a wide zone of glands full of small vesicles, colourless, of low refracting power, and opening on the cuticle. The swimming limbs have one large gland in the basal joint. All these glands appear to be excretory, and the view that some are of use in the search for the opposite sex is incorrect.

An account is given of the nervous system of *Diaptomus Castor*, which was hitherto very imperfectly known. The brain is formed of a central fibrillar mass, and a more or less thick, peripheral layer of cells. It gives rise on the dorsal surface to an unpaired prolongation which soon divides into two symmetrical branches which are directed forwards. The subœsophageal mass is formed of three ganglia, and has the thoracic mass separated from it by a slight constriction. The latter contains four ganglionic swellings. A detailed account is given of the nervous system of *Diaptomus*, and that of other Calanidæ is said to be exactly similar to it. Certain peculiarities in the nervous system of *Cyclops* which escaped the notice of Hartog are pointed out. The same system in the Harpacticidæ is distinguished by a very great fusion of the ganglia. M. Richard thinks that Hartog was wrong in denying the existence of a neurilemma in *Cyclops*; it is found in all Copepoda; and he fails to find the multipolar nerve-cells described by that author.

All Copepods have the structure of eye described by Hartog in *Cyclops*; *Bradya Edwardsi*, however, is eyeless, though capable of dermatoptic sensations. The organ described by Hartog as auditory is a unicellular gland, and no Copepod is known to have a special organ of hearing.

On the fifth pair of the legs of the males of the Calanidæ there are special structures which probably serve as organs of special sensation in copulation.

In conclusion an account is given of the French Copepoda, among which are a number of new and interesting forms.

Synapticola—a new parasitic Copepod.*—Dr. W. Voigt describes *Synapticola teres* g. et sp. n. from *Synapta Kefersteinii* Sel. In cross section the body is almost cylindrical posteriorly, slightly flattened anteriorly. The thinner posterior part of the body begins with the fifth thoracic segment. There are eleven segments; but the head and the first thoracic segment are fused, and in the female the sixth thoracic segment and the first abdominal (Milne Edwards and Della

* Zeitschr. f. Wiss. Zool., liii. Suppl. (1892) pp. 31-42 (1 pl.).

Valle) or the first and second abdominals (Claus) are fused. There is no rostrum; the anterior antennæ are short and seven-jointed; the attaching antennæ are three-jointed, and have large movable hooks; the mandibles have no palps; the maxillæ are very rudimentary; the anterior maxillipedes are two-jointed, without exopodite; the posterior maxillipedes are markedly different in the two sexes; the swimming appendages from the first to the fourth pair are very uniform; the fifth pair are rudimentary; the rudimentary sixth pair are present only in the male.

Males of Caligidæ.*—In this communication Prof. P. J. van Beneden describes the males of *Pandarus Cranchi* and of *Dinemoura elongata*, the male and female of *P. affinis* sp. n., and a new genus which he calls *Chlamys [incisus]*. This last is a Pandarine allied to *Gangliopus*, *Phyllophora*, and *Anthosoma*, and is very near to *Lepidopus* of Dana, whose generic name has long been used for a fish.

New Species of British Lernæopoda.†—Mr. W. F. de V. Kane, in describing *Lernæopoda bidiscalis*, remarks that no observations appear to have as yet been made as to the mode of impregnation among the Lernæopodidæ. He has discovered spermatophores attached to the genital orifices of a female; they have the form of transparent ovoid sacs, with peduncles crossing each other between the genital styles. These styles appear to be true thoracic appendages, and those of the male seem to be used in the application of the spermatophore, for which the peculiar shape of the distal extremity is adapted. The new species has been found at Polperro on *Mustelus canicula* and on the west coast of Ireland on *Galeus vulgaris*.

Vermes.

a. Annelida.

Auditory Organ of Arenicola.‡—Prof. E. Ehlers describes the "ear-sacs" of *Arenicola marina*, *A. Claparedii*, *A. Grubii*, and *A. antillensis*. They differ remarkably in the several species. As there is no direct evidence that the worms hear by these sacs, it is important to compare their structure with that of perhaps analogous organs in other animals. In the above-named species, except *A. Claparedii*, the sacs are vesicles formed from the skin and containing otoliths, but in the lining epithelium there is no differentiation into little hairs or rods such as one would expect in a truly auditory organ. It may be that the structures are "statocysts" or organs of equilibration, like similar sacs in other animals. In *A. Claparedii* the simplest form occurs, for there is merely an open groove without either otoliths or neuro-epithelium; in *A. marina* the sac communicates with the exterior by means of a narrow canal, and the contained particles are foreign bodies; in *A. Grubii* and *A. antillensis* the sacs are closed otocysts, and the otoliths are intrinsic formations. They differ also in their relations to the musculature, &c.

Prof. Ehlers discusses the structure of the head in the four species named, especially as regards the head-lobe and the ciliated groove on

* Bull. Ac. Roy. Belg., lxii. (1892) pp. 220-35 (2 pls.).

† Proc. R. Irish Acad., ii. (1892) pp. 203-11 (2 pls.).

‡ Zeitschr. f. Wiss. Zool., liii. Suppl. (1892) pp. 217-85 (4 pls.).

each side of the brain which corresponds to the neck-organ of other Annelids. The species in which the head-lobe has richly innervated anterior corners have otocrypts with foreign bodies (*A. marina*) or simple pocket-like grooves (*A. Claparedii*); the other two species are without the sensory protrusions and have closed otocysts with intrinsic otoliths. In *A. Grubii* the brain has a commissural structure and the neck-organs are widely open; a concentration of the nervous mass and a contraction of the neck-organs are associated with the presence of otocrypts.

The auditory organs do not arise from neck-organs. The latter are innervated from the brain, belong to the head-lobe, are constituents of the prosoma, and are perhaps comparable with paired sense-organs on the apical plate of the Trochophore. The auditory sacs are innervated from the œsophageal ring. Nor can the sacs be compared with the seta-sacs of parapodia, for, apart from other reasons, both dorsal and ventral branches of the parapodia occur in *Aricia acustica* along with otocysts. Dr. Ehlers is rather inclined to regard the otocysts as organs substituted for cirri, and to believe that they may have been originally distributed in segmental order on the parapodial surface of the body. He concludes his memoir with a general comparison of lateral sensory organs.

Encystment of Acolosoma and Earthworms.*—Prof. F. Vejdovsky brings forward evidence to show that the species of *Acolosoma* can form a true cyst. He compares with this the formation of special cavities by certain Lumbricidæ, and he ascribes both sets of phenomena to the rest required after a period of asexual reproductive activity; in other words, he compares them directly to the phenomena of encystment seen among Protozoa.

Intestinal Cilia of Lumbricus.†—Miss M. Greenwood, who has been investigating the presence of retractile cilia in the intestine of the earthworm, finds that the digestion of food in this worm is effected mainly by a secretion which is found in the granules of unicellular glands. These gland-cells stand singly, and may be placed throughout the entire length of the typhlosole, and over a corresponding region of the walls of the intestine. The absorption of digested food appears to be carried out by the cells which surround the glands; these are elongated, branch internally, and have no firm lateral connections. The edges which are turned towards the lumen of the intestine are expanded, and appear to meet over the depressed gland-cells. There is a hyaline basal band which is pierced by, or apparently gives rise to cilia; during the digestion of fat any epithelial cell by which it is absorbed shows a striated external border which replaces the active cilia. These ingestive cells are localized in a zone which recalls the mode of distribution of the unicellular glands, and they are more striking on the typhlosole than on the intestine proper. Cilia are absent at times from a much larger area of the typhlosole than that over which the ingestion of fat extends; and it is, therefore, possible that there is a connection between the absorption of matters in solution and structural change in the epithelial cells. It appears possible that there is a certain excretion of solid

* Zool. Anzeig., xv. (1892) pp. 171-5.

† Journal of Physiology, xiii. (1892) pp. 239-59 (1 pl.).

matter into the cavity of the gut of *Lumbricus*. The obvious mobility of the cells in a condition of hunger recalls the statement that the flagella of the endoderm cells of *Hydra* are retracted during digestion.

New Earthworms.*—Dr. W. B. Benham gives descriptions of three new species of Earthworms—*Plutellus perrieri* from Massart, Queen Charlotte's Island, British Columbia, *Microchæta papillata* from Natal, and *M. Belli* from East London, Cape Colony. With regard to *Plutellus* the author modifies Perrier's generic diagnosis, according to which the funnel of the nephridia does not perforate the septum, and the ovary is set in front of the testis. Very full accounts are given of the structure of the three worms, and some corrections are offered to previous descriptions of *Microchæta*. In conclusion Dr. Benham makes some criticisms on the genus *Kynotus* lately described by Michaelsen from Madagascar; he thinks it is not as aberrant as its author believes, and that it is a very close ally of *Microchæta*, the link between it and *M. rappi* being provided by the new species described in the present communication.

Earthworms from Algeria and Tunisia.†—Mr. F. E. Beddard has a note on a small collection of earthworms made by Dr. J. Anderson. *Allolobophora complanata* Dugès is known from the South of Europe, and *Microscolex algeriensis* is a new species. An account is also given of *M. Poultoni* sp. n. from Madeira. A table is given by which the now four known species of *Microscolex* may be distinguished from one another.

Species of Perichæta.‡—Mr. F. E. Beddard describes some species of the genus *Perichæta* (s.s.) from various localities; these are *P. sumatrana* Horst, *P. Dyeri* (Hab. doubtful), *P. sinensis* (from Foochow), *P. bermudensis* (from Bermuda), *P. taprobanæ* (from Ceylon), *P. Morrisi* (from Penang), *P. barbadensis*, *P. hesperidum*, and *P. mauritiana* (from Mauritius)—all new.

The author points out that the principal external features which seem to be of importance, are:—

- (1) Whether the ventral setæ are larger than the rest.
- (2) The number of setæ upon the segment.
- (3) Whether the clitellum includes the whole of segments xiv.—xvi.
- (4) Whether the setæ are present or absent from some or all of the clitellar segments; and if present, whether they are modified.
- (5) The number and arrangement of the anterior and posterior genital papillæ.
- (6) The position of the atrial pores upon the 18th segment.
- (7) Colour, size, and number of segments.

The chief internal characters which show variations are the spermathecæ and the atria; the intestinal cæca are less useful.

B. Nematelminthes.

Development of Excretory Organ, Lateral Lines, and Cœlom of Nematodes.§—Dr. O. Hamann describes the lateral lines of Nematodes

* Proc. Zool. Soc. Lond., 1892, pp. 136-52 (2 pls.).

† Tom. cit., pp. 28-37 (2 figs.).

‡ Tom. cit. pp. 153-72 (2 pls.).

§ Centralbl. f. Bakteriöl. u. Parasitenk., xi. (1892) pp. 501-3.

as arising in the following way; the mesodermal cells, while secreting contractile substance in the form of longitudinal muscular fibrils on their outer surface, or that turned towards the surface of the body, are on either side broken up by the developing longitudinal ridges of the ectoderm that form the lateral lines. The musculature and the lateral lines are developed at the same time. The muscle cells that line the cœlom remain permanently epithelial and arranged in one layer, so that they may be regarded as epithelio-muscular cells. This is the same arrangement as the author has already described for the Echino-rhynchi.

From their position it would be supposed that the excretory vessels, like the lateral lines, are of ectodermal origin, but, as a fact, they are mesodermal; for they are derived from one or two cells of the cœlom. In the stage in which the gonads consist of an undifferentiated mesoderm-cell, the excretory organ consists also of only one cell. In larvæ taken from the body-cavity of *Mugil cephalus* and 0.5 cm. long this cell was elongated, and was attached by one end in the region of the nerve-centre; within the cell the excretory canal was already laid down as a simple narrow vessel.

It appears to be true of all Nematodes that the excretory organ does not lie directly in the lateral ridges, but always in its connective tissue, which is only in very close connection with the ridges. These ridges serve as supporting tissue and generally exhibit a structure different from that of the skin, although they are directly continuous with it.

The generative organs and the intestine lie in the cœlom, and the latter has a wall consisting only of endoderm, and bounded on the side of the cœlom by a membrana propria. There is no splanchnic layer of mesoderm in the wall of the intestine. This is explained by the fact that the mesoderm, at the end of its development, consists of an equally developed cellular layer, which lies directly on the ectoderm and is only interrupted by the lateral ridges. The cœlom is now already present. This cœlom is, therefore, not homologous with that of Annelids, but is a special formation, and, as some would say, an example of abbreviated development.

Filaria tricuspis.*—Dr. von Linstow finds that under the name of *Filaria attenuata* two species have been described; the true *F. attenuata* is found in Raptorial Birds, while that found in Crows is Fedschenko's species *F. tricuspis*; of the latter a descriptive account is given. There are several species of the genus which resemble it in having the head-end armed with a tridentate process—*F. obtusa*, *F. pungens*, *F. ecaudata*, and *F. flabellata*, and these are all found in Birds. The author draws attention to the points by which they may be distinguished. He concludes with some notes on blood-filariæ and on the larval form.

γ. Platyhelminthes.

Tetrastemma lacustris [e].†—M. G. du Plessis describes a new species of Nemertine from the Lake of Geneva. It is at once distinguished by the possession of large oval concretions in the skin, which are highly

* Arch. f. Naturgesch., lvii. (1891) pp. 292-305 (1 pl.).

† Bull. Soc. Vaud., xxviii. (1892) pp. 43-8 (1 pl.).

refractive and probably calcareous. They recall exactly the bodies found in Cestodes, and the author suggests that the free Cestodes which have been described from the Lake of Geneva are nothing more than dead and altered examples of this Nemertine. The new worm is from 25 to 30 mm. long.

Development of Rhabdocœla and Triclad.*—M. P. Hallez points out a developmental law in these two groups, which he unites as Turbellaria diploblastica, while eliminating the order Dendrocœlida. The larvæ of these animals are spherical or slightly ovoid; and the mouth occupies one extremity. The provisional pharynx, which has no sheath, is terminal, and recalls the arrangement of the mouth in the ciliated larvæ of the Anthozoa. If we make the mouth point downwards, we may divide the body into a cephalic and a caudal hemisphere. These two undergo unequal development; the latter may grow more quickly than the former, when, as a consequence, the pharynx of the adult is more or less anterior, and the buccal orifice is directed forwards; e. g. *Plagiostoma rufodorsatum*. When, in a second case, the rapidity of growth is equal for the two hemispheres, the pharynx of the adult is median, and the axis of the pharynx is perpendicular to the ventral surface; e. g. various *Mesostoma*. Thirdly, the caudal hemisphere may grow less quickly than the cephalic, when the pharynx becomes situated in the second half of the body, and the buccal orifice is directed backward; e. g. *Monotus fuscus* and the Triclares.

The unequal development of the two hemispheres gives rise to other consequences; the point of insertion of the pharynx into the intestine appears to be in the direction of the most rapid growth, the mouth remaining fixed. The conversion of the primitive radial symmetry into the bilateral symmetry of the adult is also a consequence of the unequal growth of the hemispheres. The long axis of the ovoid body is the antero-posterior axis of the adult, but does not correspond to the long diameter of the ovoid larva.

As the pharynx becomes displaced from the anterior extremity backwards the body becomes gradually flattened. While it is almost ovoid in species with an anterior pharynx, it becomes almost ribbon-like in the Monotidæ and the Triclares; while there is a complete series of intermediate types between these two extreme forms. The species with a posterior pharynx pass successively, in the course of their individual development, through stages in which the pharynx is anterior and then median. Those are the best swimmers that have their pharynx anterior, as the body is more ovoid in form; those with a median pharynx crawl or swim indifferently, while those with a posterior pharynx only crawl. The triclad intestine is a consequence of the exaggeration of the flattening of the body.

If we represent by MV the amount of movement of the caudal hemisphere, and by mv that of the cephalic, we have three cases.

(1) $MV > mv$. The pharynx is situated in the anterior half of a more or less ovoid body; the animal swims; the testes and vitelline glands are compact.

(2) $MV = mv$. The pharynx is median, body flattened; the animal

* Comptes Rendus, cxiv. (1892) pp. 1033-5.

swims or crawls; the vitelline glands are always compact, but the testes may be (Alloiocœla) follicular.

(3) $MV < mv$. The pharynx is posterior, the body much flattened; the animal crawls; the testes first (Alloiocœla), the vitelline glands later (Triclades), become follicular.

Teratological Origin of two Species of Triclads.*—M. P. Hallez, who in the course of his researches on the embryology of Triclads has had occasion to observe some monstrosities, calls attention to the anastomosis or partial fusion of the two recurrent branches of the enteron, and to the multiplicity of the pharynx. The former phenomenon is common in *Dendrocœlum*; the latter is rare, and only three cases have been observed. Now the genus *Phagocata* presents all the characters of *Planaria*, save in its possession of a multiple pharynx, and the fusion of the enteric branches has been observed in *Dendrocœlum Nausicaæ*. The author suggests that these are both teratological species.

Land Planarians.†—Herr G. H. Lehnert prefaces an account of his observations on Land Planarians with a historical notice; in this he, as some others, omits to notice the observations by Prof. Jeffrey Bell which were communicated to the Society in 1886.‡ He distinguishes a variety of *Bipalium Kewense*, which he calls var. *viridis*, and he suggests that *B. dubium* described from West Sumatra is a synonym, and that that locality is the original home of the species, the habitat of which has not yet been certainly determined. The author's observations have extended also to *Geodesmus bilineatus*, and he states very fully all that he has to say regarding these two species of Land Planarians; of this species he thinks the original home must be the East or West Indies. His anatomical remarks bear on some points only of the structure of these interesting worms. A bibliography of 40 titles completes the memoir.

Land Planarians from Lord Howe Island.§—Prof. W. Baldwin Spencer gives a description of the species recently collected by Mr. Whitelegge in Lord Howe Island. The absence of *Geoplana*, of which thirty-five species are known from the Australian continent, is of interest, as is the presence of a new genus, which it is proposed to call *Cotyloplana* (*C. whiteleggii* and *C. punctata* spp. nn.). The genus *Cotyloplana* is diagnosed as having the body flattened, a sucker on the ventral surface close to the anterior extremity, and two eyes. Six new species of the genus *Rhynchodesmus* were also found. Anatomical details are promised in a succeeding paper.

Anatomy of Ectoparasitic Trematodes.||—Herr C. Dieckhoff commences with an account of the vitello-intestinal canal, the characters of which he describes for *Polystomum integerrimum*, *P. ocellatum*, *Octobothrium merlangi*, *O. lanceolatum*, *Diplozoon paradoxum*, and *Axine belones*. In all of these forms he shows that the organ is found, and

* Comptes Rendus, cxiv. (1892) pp. 1125-8.

† Arch. f. Naturgesch., lvii. (1891) pp. 306-50.

‡ See this Journal, 1886, p. 1107.

§ Trans. Roy. Soc. Victoria, ii. (1892) pp. 42-51 (2 pls.).

|| Arch. f. Naturgesch., lvii. (1891) pp. 245-76 (1 pl.).

he combats the view of Ijima that it does not coexist with the canal of Laurer. For the present we must be content to regard the organ as one *sui generis*, and consider that its genetic relations are altogether doubtful. It must not be supposed to have any very great significance, for it is wanting in many ectoparasitic and all endoparasitic Trematoda.

An account is next given of the anatomy of *Octobothrium lanceolatum*, which was examined after staining in Canada balsam. *O. merlangi*, which has many points of resemblance to it, is next more shortly described. *Polystomum ocellatum*, from the pharyngeal cavity of *Emys europæa*, is, lastly, fully described; but here, again, details only are given.

Excretory System of Temnocephala.*—Prof. W. A. Haswell points out that the mode of opening of the excretory system of *Temnocephala*—by means of two dorsally and anteriorly placed apertures—is not as rare among Trematodes as it was once thought to be. Braun has shown that any other mode of opening is exceptional among the Monogenea. The excretory system of *Temnocephala* is, however, remarkable in several points; each of the two excretory openings leads into a thick-walled contractile terminal sac, pyriform in shape, with a curved apex. A layer of muscular fibres incloses the sac, but the greater part of the thickness of the wall is due to a thick layer of finely fibrillated protoplasm. This terminal sac is a perforated cell, with its nucleus situated in its narrower posterior portion. The main excretory canals are, therefore, intracellular; the walls of the entire system, so far as the larger trunks are concerned, are composed of a few greatly produced, and sometimes branched cells. The main branches give origin to a system of canaliculi; and there are a few ciliary flames. Each main trunk gives off a branch which quickly divides into a number of vessels which enter the wall of the terminal vesicle and ramify through its substance, giving rise to a system of exceedingly fine capillary channels. We have, then, this remarkable result, that in the substance of the perforated cell there is a richly ramifying system of capillaries containing a number of ciliary flames. This arrangement is paralleled by certain of the unicellular glands in the same animal, in which a breaking up of the duct into a number of channels within the protoplasm is distinctly traceable in sections of specimens fixed with Flemming's solution.

Distomum folium.†—Prof. M. Braun, doubtful as to some of the peculiarities of structure ascribed by Zschokke, has made an independent investigation of this parasite; he finds that its anatomy is of a more normal type, and he recommends the use of serial sections as being the mode of investigating the worm with the best results.

Euryœlum Sluiteri.‡—Dr. M. Braun gives reasons for thinking that this Distomid, which was discovered by the late Dr. Brock on *Diacope metallicus*, and for which a new genus was made, belongs really to *Apolema*, from all the known species of which it differs by the great width of the collecting spaces of the excretory organs as well as by the large size of some of the other parts.

* Zool. Anzeig., xv. (1892) pp. 149-51.

† Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 461-3.

‡ Tom. cit., pp. 727-9.

Liver Flukes.—A paper by M. Francis* is noticed by Dr. C. W. Stiles † who points out that the proposed new species, *Distoma texanicum*, is identical with Hassall's *D. americanum*. It is very possible that this last is the same as Bassi's *D. magnum*, which is not, as some have supposed, merely a large example of *D. hepaticum*.

Tæniæ of Freshwater Fishes. ‡—Herr A. Kraemer describes the structure of certain freshwater *Tæniæ*. In *Tænia filicollis* Rud. from *Coregonus ferox* there is a porous cuticle of two lamellæ, a finely striated cutis, a muscular layer of circular and longitudinal muscles, and a sub-muscular layer of vesicular cells, within which there is a strong internal longitudinal musculature. There are two nerve-strands, four longitudinal excretory vessels, which are united on the posterior margin of each proglottis, and in an annular anastomosis beneath the brain. The gonads are described in detail, but have no very remarkable peculiarities. The author points out that *T. ocellata* is only *T. filicollis* modified by parasitism in a larger host. He also describes the rarer *T. torulosa* Batsch from *Alburnus lucidus*, which has hitherto been almost uninvestigated. The joints are very short and the organs consequently much compressed, but the general structure is very like that of *T. longicollis* Rud. recently described by von Linstow.

Gonads of *Tænia botriophthis*. §—Dr. C. de Filippi describes the reproductive system of this parasite of the fowl. The gonads are completely developed in the 180th proglottis; the genital pores are unilateral; there are no seminal vesicles, nor is there a uterus; the ovary contains the eggs before and after fertilization, and afterwards forms ovigerous capsules, which, with their contained larvæ, invade the whole proglottis.

A rare Abnormality in a Tapeworm. ||—Dr. M. C. Francaviglia describes a specimen of *Tænia solium*, in which the hooks were completely absent, while in place of them there were twelve large papillæ like those of some Nematodes.

Parasites of North Atlantic Balænopteridæ. ¶—Herr L. A. Jäger-skiöld reports four round and flat worm parasites from *Balænoptera rostrata*, five from *B. borealis*, two from *B. musculus*, and three from *B. Sibaldi*. *Ogmogaster plicatus* is found in the first three, *Echinorhynchus turbinella* in the second and third, and *Ascaris angulivalvis* in the first and fourth.

δ. Incertæ Sedis.

Genera of Enteropneusta. **—Prof. H. Spengel distinguishes nineteen species and four genera of this remarkable group. The genera may be distinguished by the characters of the musculature of the body;

* Bull. Texas Agricult. Stat., 1891, 9 pp. (6 figs.).

† Centralbl. f. Bakteriolog. u. Parasitenk., xi. (1892) p. 608.

‡ Zool. Anzeig., xv. (1892) pp. 14-8.

§ Boll. Soc. Rom. Stud. Zool., i. (1892) pp. 75-9 (1 pl.).

|| Tom. cit., pp. 31-5 (1 fig.).

¶ Biol. Foren. Förhandl. Stockholm, iii. No. 7. See Biol. Centralbl., xi. (1892) p. 574.

** Verhandl. Deutsch. Zool. Ges., 1891, p. 47. See Amer. Nat., xxvi. (1892) p. 348.

Ptychodera has an outer circular musculature, *Glandiceps* and *Schizocardium* have internal circular muscles, while in the true *Balanoglossus* there are no circular muscles.

Geographical Distribution of Marine Rotatoria.*—Dr. E. v. Daday gives a list of marine Rotatoria, and tabulates (i.) those (28) species that are exclusively marine, (ii.) those (32) that are marine and lacustrine, (iii.) those (6) that are marine and lacustrine and also found in inland salt lakes. He further gives lists of the Rotifers found in the sea and inland salt lakes, in freshwater lakes and salt lakes, and in fresh and brackish water.

From these lists it is very evident that marine Rotifers have not yet been properly sought for by naturalists, for Dr. Daday can only enumerate 3 species from the North Sea, 2 from the Indian Ocean, and 1 [and that one wrongly] from the Pacific, and none at all from the Atlantic. We think Dr. Daday could have found a few more marine species by carefully looking over the pages of Hudson and Gosse's monograph: *Salpina marina*, *Diaschiza fretalis*, *Diglena suilla*, *Notholca scapha*, *Distemma platyceps*, *Furcularia spherica*, and some more are therein indicated as marine.

The author, however, makes a mistake in including *Trochosphaera æquatorialis* among the marine forms; this species was first found by Dr. Semper in freshwater pools of rice fields in the Philippine Islands, and recently by Surgeon Gunson Thorpe, R.N., in a pond in the Botanical Gardens of Brisbane, Australia; there is no record of its having been found in the sea.

We notice also that Dr. Daday uses many names which have been changed by the new classification of Hudson and Gosse. Their admirable monograph being the only book of reference extant for Rotifers, we cannot help thinking that all workers in this field will avoid much confusion by calling the Rotifers by the generic names therein given them.

Studies on Rotifers.†—Dr. C. Zelinka, prompted by the desire to set at rest all doubts as to the relationships of Rotifers to the larvæ of Annelids, has made a series of important anatomical and embryological studies.

He begins with a detailed account of the structure of *Callidina russeola* with which other species are compared. He emphasizes the necessity of taking account, in all determinations of species, of the following characters—maximum length, relation of length and breadth in creeping and rotating, the form of the "rotatory organ" and upper lip, the colour of the gut and of the skin, the nature of the skin, whether spiny, warty, granular, or otherwise, the form and size of the jaws and their position in the body when extended, the number of teeth, the form of the foot, of the prongs, of the terminal joint, the form of the proboscis, the position of the gonads, and the number of ciliated lobes.

Zelinka then discusses the symbiosis between Rotifers and liverworts and three new symbiotic species are described. He devotes some care to answering Goebel's criticism of his previous observations on this

* Math. u. Naturw. Ber. aus Ungarn, ix. (1891) pp. 55-66.

† Zeitschr. f. Wiss. Zool., liii. (1891) pp. 1-159 (6 figs. and 6 pls.).

symbiosis. In regard to the revivification of Rotifers after desiccation, he denies the justice of the conclusions of Zacharias and criticizes some of Plate's observations. He thinks it premature to conclude that only the moss-inhabiting Rotifers can survive desiccation, and protests against generalizing from a few observations.

The author then describes the development of *Callidina* and *Melicerta*—the extrusion of the polar body, the segmentation, the appearance of the various organs, their subsequent differentiation, and the hatching.

The ovum of Rotifers is bilaterally symmetrical; the polar body is extruded on the dorsal surface of the future embryo, in *Melicerta* nearer the subsequent posterior pole, in *Callidina* almost at the subsequent anterior pole; the first cleft separates unequal parts; the smaller part, exclusively "animal," occupies the lower end, the larger part, both "animal" and "vegetative," occupies the upper end. The segmentation is unequal, there is no segmentation cavity, the gastrulation is epibolic. There is no unified mesoderm comparable to that of worms and other bilateral animals. Only isolated organ-rudiments occur, of which only the granular cells outside the pharynx give rise to the elements of coelomic muscles. The skin muscles separate from the epidermis, the genital cells arise from the gut-rudiment, the cement-gland is an ectodermic invagination, the excretory system is at least not endodermic. The ectoderm is active in development, the endoderm is passive.

In the occurrence of apical plate, longitudinal muscles, head-kidney, &c., the embryonic Rotifer is like a Trochophore, but there are no mesodermic bands. The Rotifer embryos are therefore below the Trochophore level. In the possession of a post-oral ventral ganglion they approach the Trochophore of Molluscs, and they show affinities with the type from which Nematodes, Polyzoa, Brachiopods, and Chætognatha are derivable. In the possession of a post-abdominal region during development and in the occurrence of mobile appendages in *Hexarthra* they approach Crustacea. Finally the development suggests derivation from the Protrochophore of Plathelminthes.

Echinodermata.

Origin of Radiate Symmetry.*—Prof. O. Bütschli makes a strenuous attempt to show how the radiate symmetry of Echinoderms may have arisen from a bilateral condition. His general idea is that the ancestral form fixed itself on its right side, and that there ensued a partial reduction of that side. It is not possible, however, to follow Bütschli's intricate speculation without constant reference to his figures.

Echinoderms of Kingston Harbour, Jamaica.†—Mr. G. W. Field reports that the Echinoderm-fauna of Kingston Harbour is rich beyond expression, especially in the numbers of individuals of many of the species, twenty-eight of which were noted. The most abundant is *Toxopneustes variegatus*, which is found over almost the entire bottom of the harbour; its eggs are the most favourable for study the author has ever seen, and the larvæ can be easily reared. It is able to hide

* Zeitschr. f. Wiss. Zool., liii. Suppl. (1892) pp. 136-60 (1 pl., 4 figs.).

† John Hopkins Univ. Circ., xi. (1892) pp. 83-4.

itself under a load of débris which it holds on its back by its feet. The most strikingly conspicuous creature on the coral reefs is the formidable *Diadema setosum*. The Asterida were the smallest in number of individuals. Differences of coloration in the sexes of a species of *Ophiothrix* were observed.

New Genus of Echinoids.*—Mr. J. W. Gregory defines a new genus *Archæopneustes*, in which he places the *Palæopneustes hystrix* of A. Agassiz, a new fossil species from Barbadoes, which he calls *A. abruptus*, and *Asterostoma cubense*, of Cotteau. In these three species the petals are continued to the margin, and the mouth is very excentric anteriorly, whereas in *Palæopneustes* the petals are short and closed, and the mouth is more central. The first genus has, further, an elliptical and conical test, and the second one that is more evenly rounded.

An abnormal Cucumaria.†—Prof. H. Ludwig describes what looks like a two-headed specimen of *Cucumaria planici*. The supernumerary anterior outgrowth, which lay between the two left ambulacra, included a duplication of the parietal organs—water-vascular vessels, nerves, blood-vessels, and muscles, but did not include any repetition of the gut.

Cœlenterata.

East African Coral Reefs.‡—Dr. A. Ortmann briefly describes these as true fringing reefs, associated with "negative shore displacement," i. e. elevation of the coast. To the south of the district visited (from Zanzibar to Mikindani), where deep water occurs close to the shore, the reefs are narrow, in other parts the shallow water has admitted of broad, flat reefs. No true barrier-reefs or atolls were seen. These, he believes, can arise only in regions with a positive shore displacement, or in rare cases in stationary regions. He holds to the "Darwin-Dana" theory, and rejects Guppy's conclusions. The atolls which J. Walther described in the Red Sea are not true atolls. Ortmann observed that corals (*Porites*, *Goniastrea*, *Cœloria*, *Tubipora*) may survive low-tide exposure for hours. He also found some living on a loose substratum of sand and gravel held together by sea-grass.

Cassiopea xamachana.§—Mr. R. P. Bigelow gives an account of this new species from Jamaica. It is allied to *C. andromeda* Esch. and *C. polypoides* Keller. An important part in reproduction is played by the production of buds by the Scyphistoma. The bud is set free as a ciliated, hollow, planula-like body consisting of a layer of ectoderm and of endoderm, with a thick supporting layer between, in which the four septal muscles are imbedded. After the formation of a mouth the larva becomes fixed and develops into a Scyphistoma. Strobilization is monodiscous. More detailed accounts follow.

Development of Marginal Sense-organs of a Rhizostomatous Medusa.||—Mr. R. P. Bigelow finds that Goette's view, which he was inclined to adopt, that the rhopalia are formed as evaginations from the under surface of the marginal part of the umbrella, entirely independently

* Quart. Journ. Geol. Soc., xlviii. (1892) pp. 163-9 (1 pl.).

† Zeitschr. f. Wiss. Zool., liii. (Suppl.) pp. 21-30 (1 pl.).

‡ Zool. Anzeig., xv. (1892) pp. 18-20. § Tom. cit., pp. 212-4.

|| John Hopkins Univ. Circ., xi. (1892) pp. 84-5.

of the larval tentacles, is erroneous, so far at any rate as *Cassiopea xamachana* is concerned. The beginning of the formation of the rhopalium is marked by the appearance of otoliths which arise as glistening white bodies in the tentacle, just beyond the apex of the marginal lobe. A little later a slight elevation is noticeable on the aboral side of each rhopalial tentacle, immediately external to the mass of concretions. The epithelium at this point is pigmented, and forms the first rudiment of the eyes. As the marginal lobe grows, a process is formed on each side of the tentacle, and a ridge on the aboral side connects them. These processes finally form the rhopalial lobes of the umbrella, and the connecting ridge grows out over the rhopalium as the hood. At length a stage is reached in which, while the distal part of the rhopalial tentacle retains its structure and is completely functional as a tentacle, its basal portion is a well-developed rhopalium; in this latter the differentiation of the ectoderm into sensory epithelium, eyespot, and nerve-fibre-layer is complete. The next stage in the development of the rhopalium is the absorption of the distal portion of the tentacle, and when the stump is finally absorbed there is a fully formed rhopalium with a thick layer of nerve-fibres and a cup-shaped ocellus.

Reproduction by Budding in Discomedusæ.*—Mr. R. P. Bigelow considers that in such cases as have already been reported budding appears to be merely an incident in the life-history of the individual. In *Cassiopea xamachana* it is an important if not the chief factor in the perpetuation of the species. The bud appears as a slight swelling on the body of the scyphistoma near the stem, and involves all three layers of the body; as it grows the opening between it and the cœlenteric cavity of the scyphistoma is gradually closed by a constriction. The constriction increasing, the bud becomes set free as a pear- or spindle-shaped ciliated body. This mode of budding is probably the most highly specialized of those as yet known; it seems to be an especial adaptation to overcome the unfavourable effect on the distribution of the species caused by the sedentary mode of life of the adult, a mode very unusual with Medusæ. As it dwells on the bottom in quiet lagoons and bays, its eggs stand little chance of wide distribution, and the planulæ would probably not swim very far from their mother before becoming fixed. The individual buds probably do not swim very far either, but the last of a series of generations of buds may be at a great distance from the parental, sexually produced scyphistoma.

Siphonophore from Plymouth.†—Mr. J. T. Cunningham has a note on a Siphonophore which was found in great abundance close to Plymouth breakwater in September 1891. He calls it *Muggiæa atlantica*, and shows how it is to be distinguished from *M. Kochi* Hæckel, of which *M. pyramidalis* and *M. primordialis* are stages.

Dendroclava Dohrni.‡—Dr. R. Zoia describes some specimens of this hydroid. He agrees with Weismann, its original describer, in assigning it to the sub-family Pandæidæ of the Tiaridæ, but he points

* John Hopkins Univ. Circ., xi. (1892) pp. 71-2.

† Journal Marine Biol. Ass., ii. (1892) pp. 212-5 (2 figs.).

‡ Boll. Scientif., Nos. 3 and 4, 1891. See Ann. and Mag. Nat. Hist., tx. (1892) pp. 409-11.

out that it cannot be a *Conis*, for it has no double crown of tentacles bearing ocelli on the shorter and upper of these bodies. Weismann supposed that it was a deep-sea form, but Dr. Zoia's specimens came from water of inconsiderable depth.

Porifera.

Sponge-remains in Lower Tertiary Strata of New Zealand.*—Dr. G. J. Hinde and Mr. W. M. Holmes have examined the sponge-remains from beds of siliceous or siliceo-calcareous material found near Oamaru, South Island, N.Z. It is the same deposit as that which contained the diatoms described by Messrs. Grove and Short in the *Journal of the Quekett Microscopical Club* for 1886 and 1887.

The probable number of genera and species of the different divisions of siliceous sponges is—

Monactinellid,	70 species and 24 genera ;
Tetractinellid,	22 " 9 "
Lithistid,	7 " 5 "
Hexactinellid,	11 " 5 "

but, of course, this estimate falls far short of the real number present. Nearly every hitherto known form of spicule of siliceous marine Sponge, both skeletal and flesh-spicules, is represented in the Oamaru deposit, if we except some of those from Palæozoic strata and a few of recent sponges. While the detached spicules appear to mostly belong to still existing genera, the species appear to be distinct from recent forms. As will be noted, there is a remarkable preponderance of Monactinellids; this is very unusual if not exceptional, and the authors point out that it is due to the conditions by which the minute and delicate spicules of the Monactinellids have been preserved. It is not, therefore, unreasonable to suppose that the absence of these sponge-spicules in the older rocks is rather due to their having perished in the fossilization than that the Monactinellids did not coexist with those other groups whose remains have been partly preserved.

Another important fact in this deposit is the association of remains of what we must, from our present knowledge, regard as abyssal forms, with others whose relations now exist in comparatively shallow water. Some sponge-genera have, however, a very wide range in depth, and it is very probable that many Monactinellid genera now considered as only existing in shallow and moderately deep water will be found, on further investigation, to be equally capable of living in the same extreme depths as the more specially abyssal Hexactinellids. The siliceous beds of Oamaru were probably formed at depths of not less than 1000–1500 fathoms.

Histology of *Leucosolenia clathrus*.†—Mr. E. A. Minchin describes the process by which the contractile ectodermal cells of this sponge pass from flattened expanded elements to contracted mushroom-like forms. The latter appearance is not found, however, in the cells which form the muscular sphincter of the osculum, or on the inside of the oscular margin; the former case may be explained by the two layers of the

* *Journ. Linn. Soc. Lond.*, xxiv. (1892) pp. 177–262 (9 pls.).

† *Zool. Anzeig.*, xv. (1892) pp. 180–4 (3 figs.).

ectoderm composing the sphincter being in immediate contact, and not separated by any jelly; while the latter is, perhaps, due to the cells being passive and not active in the contraction. The author is of opinion that Dr. von Lendenfeld's descriptions and figure of the ectoderm cells are throughout erroneous.

In the formation of pores the first stage is an ectoderm cell somewhat more granular than most, and with distinct cell-limits. Such a cell grows inwards towards the endoderm, and pushes its way between the collared cells, while retaining a connection with the ectoderm. The cell then spreads out and becomes perforated. The fully formed pore is a single cell with a nucleus exactly similar to the remaining ectodermal nuclei, and an intracellular duct, which has a wide inner opening, and a very delicate outer opening. When the sponge contracts the pores close, and then, in section, look like amœboid mesoderm cells.

The spicules always have on each arm one, sometimes two cells; each of these is closely applied to the spicule sheath; the protoplasm is very clear, and it is often hard to see its limits. The impression made is that the spicules lie in a continuous cell network. The stellate cells of the mesoderm, so often described, are exceedingly rare, if not entirely absent; what have been mistaken for them are the spicule cells, owing to the ordinary displacement of the spicules in sections.

The collared cells vary in shape, according as the sponge is contracted or expanded. In the normal condition they are without any projections, but, when observed living, they can often be seen to throw out numerous fine processes; this is always a sign of cessation of activity and of death. Lendenfeld's figures, therefore, appear to represent abnormal and pathological phenomena.

The principal method employed by the author, and one that has been fruitful of good results, was careful examination of surface views of pieces of the wall of the sponge, always preserved quite fresh from the sea on board the fishing-boat.

Adriatic Sponges.*—Dr. R. von Lendenfeld continues his monograph, discussing the calcareous forms. Of these there are 32 species, eight new. The author describes their distribution, and gives a key to the genera, and to the perplexing synonymy. He then proceeds to a systematic account of the canal system, the skeleton, and the minute structure. His classification is as follows:—

Typus, Spongiæ. Classis Calcareæ.

Ordo I. Homocœla. Family 1. Asconidæ, *Ascetta*, *Ascandra*,
Ascyssa.

„ 2. Homodermidæ, *Hometta*,
Homandra, *Homoderma*.

„ 3. Leucopsidæ, *Leucopsis*.

II. Heterocœla. „ 4. Syconidæ, *Sycantha*, *Sycetta*,
Sycandra, *Grantia*, *Grantessa*,
Ute, *Amphoriscus*, *Ebnerella*.

„ 5. Sylleibidæ, *Polejna*, *Vosmaeria*.

„ 6. Leuconidæ, *Leucetta*, *Leucandra*,
Leucyssa.

* Zeitschr. f. Wiss. Zool., liii. (1891) pp. 361-433.

Protozoa.

The Principles of Skeletal Architecture in Protozoa.* — Dr. F. Dreyer endeavours to give a mechanical rationale of the forms of skeleton in Rhizopods. He deals first with the cuticular shells of Thalamophora and the central capsules of Radiolaria, secondly with axial skeletons of Radiolarians and Heliozoa. Starting from the primitive chitinoid shell, in its various forms, he traces the strengthening of this by inorganic materials, especially carbonate of lime, or by the accretion of extrinsic particles. He follows Neumayr in tracing the parallelism between the agglutinate and calcareous Foraminifera. He regards the central capsule of Radiolarians as comparable with the cuticular shell of Foraminifera. In treating of axially arranged skeletons, Dreyer starts from the transitory formation of an axial strand in a pseudopodium. In Heliozoa he distinguishes two stages (1) in *Actinosphaerium*, &c., in which the axial needles are isolated, (2) in *Raphidiophrys*, &c., in which the needles meet in the centre. Among Acantharia, one stage—an elastic movable supporting apparatus—is reached in *Acanthometra*, another—a compacted and rigid framework—in *Acanthophracta*. Dreyer's suggestions deserve to be pondered over; justice can hardly be done to them without giving detailed illustrations of his way of interpreting the facts.

Infusorians in the Stomach of Ruminants.† — Herr A. Schuberg has studied some of the Infusorians which he and other investigators have found in abundance in the rumen and reticulum of ruminants. They eat solid particles and are rather commensals than parasites. Large species of *Diplodinium* often swallow their companions of the genera *Isotricha* and *Dasytricha*. Schuberg describes in detail the division of *Dasytricha ruminantium*, which is of especial interest in connection with the change in the position of the new mouth formed after division. After discussing the behaviour of the nuclei, the author pours scorn upon those who pretend to give a "mechanical explanation" of the division of Infusorians. The structure of the Ophryoscolicidæ, which is extraordinarily complex, is then discussed, with especial reference to the marked distinction between ectoplasm and endoplasm. The processes of division in Ophryoscolicidæ are also described.

Clathrulina and Hedriocystis.‡ — Mr. W. J. Simmons reports the discovery in Calcutta of *Clathrulina elegans*, first found by Cienkowski in St. Petersburg, and afterwards in various parts of central and western Europe, and in North America, and of *Hedriocystis pellucida* of Hertwig. We have here another example of the wide distribution of the Protozoa, a subject to which microscopists in India might profitably direct their attention.

Difflugia of Bottom of Lake of Geneva.§ — Prof. H. Blanc shows that the numerous nuclei sometimes seen in a *Difflugia* do not arise spontaneously in the protoplasm; they are the products of successive divisions. These nuclei, surrounded with protoplasm and some grains

* Jenaische Zeitschr. f. Naturwiss., xxvi. (1891) pp. 204-96 (5 pls.).

† SB. Physik.-med. Gesell. Würzburg, 1891, pp. 122-37.

‡ Science Gossip, 1892, pp. 124-7 (9 figs.).

§ Arch. Sci. Phys. et Nat., xxvii. (1892) p. 472.

of sand, form a light and incomplete shell, become detached from the individual in which they are produced, and give rise to young *Difflugia*. The cysts which are found at the bottom have nothing to do with reproduction or the preservation of the individual; they are cysts of putrefaction whose true origin is not yet known.

Coccidia.*—Sig. P. Mingazzini describes *Benedenia octopiana*, and gives a diagnosis of the genus. The cysts generally exhibit complete sporulation; the spores are oval or elliptical and very numerous; there are three falciform bodies. The cysts with falciform bodies show a residual nucleus or more than one. The members of the species are parasites of *Sepia* and *Octopus*.

Psorosperms in Coccothraustes.†—Drs. M. C. Francaviglia and C. de Fiore describe the occurrence of *Psorospermium avium* in *Coccothraustes vulgaris*, and have followed the development of the coccidia, confirming Piana's observation as to the exceptional formation of micrococci independent of previous segmentation.

New Cholera Microbe.‡—Dr. P. Hehir describes a polymorphic protozoon which he has found not only in the rice-water evacuations, but also in the blood of cholera patients. The various phases of the parasite are described with some minuteness, but it will suffice to state that the adult form, which has a long diameter of 1/500–1/1500 in., consists of a body with a cavity or vacuole, and that the body is surrounded by numerous flagella and spinous processes. The transitional forms are described as spherical, flagellated, spore-like, and amœboid, so that the parasite is truly polymorphic, or, at any rate, protean in its varieties.

There appears to be little or no difference between the appearances observed in the dejecta and in the blood, the principal feature about all the parasites being their movements and their rapid multiplication. They are found not only free in the blood-plasma, but also, as spores, in the corpuscles which by the growth of the parasite are eventually destroyed.

Inoculation experiments made by injecting dogs with the blood of cholera patients failed; while the mature parasite, "not a few of its polymorphic forms and crowds of its spores," have been found in the water of several wells.

Should these observations be confirmed, the importance of the cholera vibrio will be considerably diminished.

* Atti R. Accad. Lincei (Rend.) i., ser. v. (1892) pp. 175–81.

† Boll. Soc. Rom. Stud. Zool., i. (1892) pp. 68–74 (1 fig.).

‡ Indian Medical Gazette (Special Supplement), April 1892, 7 pp., 11 pls.



BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

a. Anatomy.

(1) Cell-structure and Protoplasm.

Irritability of Protoplasm.*—Herr E. Strasburger gives a *résumé* of all that is at present known with regard to the morphological structure and the physiological properties of vegetable protoplasm, and the part which it plays in the phenomena of irritability in the vegetable kingdom. It is accompanied by a copious bibliography.

Plasmogenous Vacuoles in the Nucleole of the Endosperm.†—M. C. Decagny finds similar phenomena in the nucleole of the endosperm of *Phaseolus* to that which he has already recorded in the case of *Spirogyra*. The mode of observation was by hardening ovules from 1 to 5 mm. in length in absolute alcohol or Flemming's solution, colouring by picocarminate or the violet mixture obtained with the aid of fuchsin or methyl-green, and then mounting in glycerin with the addition of the same staining reagents. By this means plasmogenous vacuoles could be detected, containing in solution a substance which solidifies in contact with the nuclear sap and the cell-sap. When this substance solidifies in the form of a membrane, it exhibits the homogeneity, transparency, and index of refraction of the nuclear membrane, of the membranous layer of the protoplasm, and of the achromatic filaments which arise from the indirect division of the nucleus. It follows from this that the origin of the plasmic substances such as the nuclear membrane, the achromatic filaments, and those which present similar properties and reactions, must be sought for in the nucleole, and therefore in the nucleus, not in the cytoplasm.

(2) Other Cell-contents (including Secretions).

Substances which accompany Chlorophyll in Leaves.‡—M. A. Étard records the elimination of the following substances in leaves. When the leaves of the vine are treated with carbon disulphide, a portion of the substances thus extracted is soluble, and a portion insoluble, in alcohol. The soluble portion yields a substance with the composition $C_{17}H_{34}O$, which he calls *vitol*, and a substance soluble in ether, a diatomic alcohol to which he gives the name *vitoglycol*, with the empirical formula $C_{23}H_{44}O_2$, and probably the true composition $C_{23}H_{42}(OH)_2$. This is accompanied by a triatomic alcohol, *enocarpol*. A similar treatment of the leaves of lucerne yielded a monatomic alcohol *medicagol*, with the formula $C_{20}H_{44}OH$. From *Bryonia dioica* a hydrocarbon $C_{20}H_{42}$ was obtained, which the author calls *bryonane*. The mixture of these, together with crystalline paraffins, probably constitute the substances to which the term wax of leaves has been applied. *Enocarpol*, $C_{26}H_{39}(OH)_3H_2O$, was found also in the pericarp of the grape.

* 'Das Protoplasm u. d. Reizbarkeit,' Jena, 1891. See Bot. Centralbl., 1. (1892) p. 48.

† Comptes Rendus, cxiv. (1892) p. 245. Cf. this Journal, 1891, p. 58.

‡ Tom. cit., pp. 231-3, 361-7.

Composition of Starch.*—Herren C. Scheibler and H. Mittelmeier recur to the old view that starch is a mixture of two isomeric substances, granulose and starch-cellulose, of which the former constitutes by far the largest proportion, so that almost all the reactions assigned to starch are really those of granulose. It is easily transformed into soluble products by acids and ferments, which is not the case with starch-cellulose. The carbohydrates may be classified in two principal groups, simple sugars and compound sugars, the latter, such as maltose, milk-sugar, and cane-sugar, being formed by combinations of the former with loss of water, according to the formula $n(C_6H_{12}O_6) - (n - 1)H_2O$. The so-called dextrin of commerce still contains sugar, from which it can be freed by precipitating three times by alcohol. Pure dextrin is still not an autonomous substance, but belongs to the class of carbohydrates which contain a free carbonyl.

Starch-grains of Pellionia.†—Prof. A. Dodel has investigated the structure and mode of development of the starch-grains in the stem of *Pellionia Daveauana* (Urticaceæ), and states that they are formed exclusively by apposition. All the grains are first formed as small globes, either in the middle of globular or ovoid chloroplasts, or eccentrically in the latter, often in pairs or larger numbers beneath the periphery of the green protoplast. They gradually become ovoid, bean-shaped, or club-shaped, and grow entirely by apposition. The starch-generators are regularly developed chlorophyll-grains of originally spherical or ovoid form. By the rapid growth of the contained starch-grain the chloroplast is burst, and the starch-generator is pushed aside in the form of a cap; but the starch-grains are still enveloped by an exceedingly thin layer of colourless protoplasm, and the green starch-generator frequently shifts its place on the surface of the latter during growth. The absorption of the starch-grains is effected by a diastatic ferment.

Latex of the Fig.‡—Sig. U. Mussi has investigated the composition of the latex of *Ficus carica*, and finds that it is composed of an enormous number of microscopic granules resembling in structure those of potato-starch, but containing neither starch, inulin, nor nitrogenous compounds. By filtration the latex may be divided into a liquid and a solid portion. The former contains vegetable albumin, traces of mineral salts, substances of a gummy and pectic nature, including a new digestive ferment *cradin*, glucose, and malic acid. The solid portion consists of cerotic acid, caoutchouc, a white substance insoluble in water, but soluble in cold alcohol, ether, and chloroform, and a substance occurring in thin scales, insoluble in water and in all ordinary solvents.

Composition of Albuminoids.§—M. H. Arnaud regards these substances as composed of hydrocarbons, fatty substances, and urates, in varying proportions, on which depend their different reactions. They may be looked on as compound ammonium poly-cyanates, or as com-

* Ber. Deutsch. Chem. Gesell., xxiii. pp. 3060 *et seq.* See Bot. Centralbl., 1891, Beih., p. 509.

† Flora, lxxv. (1892) pp. 267-80 (2 pls.).

‡ L'Orosi, xiv. pp. 297-304. See Journ. Chem. Soc., 1892, Abstr., p. 653.

§ Comptes Rendus, exii. (1891) pp. 148-51.

pound poly-urates, in which atoms of hydrocarbons and fatty substances have taken the place of atoms of hydrogen.

Crystalloids in the Cell-nucleus of *Convolvulus*.*—Prof. A. Borzi describes the occurrence of proteinaceous crystalloids in the nucleus of the cells of the parenchyme of the leaves and cotyledons of several species of *Convolvulus*. They occur singly or in masses, have often a rod-shaped form, and are separated from the rest of the nuclear protoplasm by a very thin protoplasmic envelope. They are found in the young cells, and the author believes them to be formed at the expense of the substance of the nucleus, as the result of a process of degeneration. They can be well shown by staining with Böhmer's hæmatoxylin after fixing by Kleinenberg's fluid; but the best reagent is a 10 per cent. solution of gold chloride, which stains the crystalloids an intense reddish-brown colour, the rest of the cell-contents a dark ultramarine.

Alkaloids of the Orchidaceæ.†—M. E. De Wildeman finds in *Dendrobium nobile* and other species of the genus, crystalloids similar to those previously found in *Epiphyllum*, which he states to be insoluble in alcohol. The reactions of the crystalloids contained in *D. nobile* are given in detail, and their presence is affirmed in the aerial roots, in the stem, in the parenchyme of the leaves, in the petals, and in the ovary. They occur in especial abundance in the cells which are in a state of active division, in the epiderm, and in the hairs; they are also found in some of the cells which contain raphides. In *D. Ainsworthii* the author found them also in the leaves and in the petals.

Crystalline Deposits in the Leaves of Anonaceæ and Violaceæ.‡—Prof. J. Borodin has examined the leaves of 340 species belonging to 38 genera of Anonaceæ, and those of 164 species belonging to 17 genera of Violaceæ, for the purpose of determining the constancy of the presence of crystals of calcium oxalate as a character for classification.

In the Anonaceæ he finds the presence of unicellular oil-glands—almost always in the spongy parenchyme—to be a constant character. This is characteristic also of the Magnoliaceæ, but not of the Ranunculaceæ. Crystals of calcium oxalate were found in 92 per cent. of the species examined, occurring either in the mesophyll, along the veins, or in the epiderm; the first of these positions is very inconstant, the second very rare, the third almost universal. In the occurrence of crystals in the epiderm, the Anonaceæ again agree with the Magnoliaceæ, and differ from the Ranunculaceæ. The author describes six distinct types founded on the form and distribution of the crystals, characteristic in most cases of the genera.

In the Violaceæ both clusters and single clinorhombic crystals occur in the leaves, and may be classified under eight types, according to their arrangement and distribution. These also correspond with the division into genera, though not so universally as in the Anonaceæ.

* Bull. Soc. Bot. Ital., i. (1892) p. 45.

† Bull. Soc. Belge Microsc., xviii. (1892) pp. 101-12 (1 fig.). Cf. this Journal, 1887, p. 983.

‡ Arb. St. Petersb. Naturf.-Gesell. (Bot.), 1891, pp. 177-205. See Bot. Centralbl., i. (1892) p. 51.

The author concludes that the presence and the distribution of crystals of calcium oxalate are not connected with physiological processes in the plant, but rather with its genetic relationships.

Silica in Plants.*—MM. Berthelot and G. André have instituted a series of experiments for the purpose of determining the proportion of silica, and the mode in which it occurs, in different stages of development in plants. The observations were made on wheat, the grains of which contain scarcely a trace of silica. The grains were sown on April 15. On April 30 the greater part of the silica contained in the stem was in the insoluble state, and must therefore have undergone a transformation after its absorption. On June 12, on the other hand, the chief part of the silica was soluble in alkalis. On June 30 at the commencement of blossoming the proportion of silica present was largest in the leaves, smallest in the inflorescence; the former was chiefly in the insoluble, the latter in the soluble condition. On July 23 the results were nearly the same. An examination of dried plants on August 18 showed that the amount of silica had increased considerably in the stem and leaves, but only slightly in the ear.

(3) Structure of Tissues.

Formation of Annual Rings.†—Prof. R. Hartig replies to some of Jost's criticisms on his explanation of the increase in thickness and formation of annual rings in dicotyledonous trees, and adduces further arguments in its support. He maintains that the number, size, and distribution of the vessels in the annual ring are in direct dependence on the area of the transpiring leaf surface, and on the amount of nutrient cambium formed. This applies to the formation of all the conducting elements in the interior of the plant,—vessels, tracheids, &c.

Bicollateral Bundles of Cruciferae.‡—Prof. A. Borzì has investigated the development and structure of the anomalous bicollateral vascular bundles in the stem and root of Cruciferae with woody stems (*Brassica fruticulosa* and *Erucastrum virgatum*). The bundle contains an internal portion of a phloem-character, and is therefore bicollateral in the true sense of the term. The internal xylem usually originates from the primitive meristem; but the cambium may form new phloem-elements in centrifugal succession, which increase the size of the original bundle. The cambium retains the power of generating centrifugally new layers of secondary phloem, in the form either of continuous or of more or less interrupted zones concentric with the axis. These layers remain attached to the secondary xylem and inclosed within it. In *B. fruticulosa* some of the bundles are deficient in the internal phloem, and the primary xylem is reduced to a small number of woody fibres, spiral vessels being entirely wanting. The root (in *B. fruticulosa*) exhibits a similar structure; the vascular bundles have bands of internal phloem due to the original activity of the cambium, which gives birth later to layers of secondary phloem, forming zones within the xylem.

* Comptes Rendus, cxiv. (1892) pp. 257-63.

† Bot. Ztg., l. (1892) pp. 176-80, 193-6. Cf. this Journal, 1891, p. 761.

‡ Malpighia, v. (1892) pp. 316-31 (2 pls.); and Bull. Soc. Bot. Ital., i. (1892) p. 60.

Secondary Xylem of the Apetalæ.*—M. C. Houlbert has undertaken an examination of the structure of the secondary wood in the orders of Apetalæ with inferior ovary, for the purpose of determining its value in connection with classification.

The Proteaceæ may be classified from this point of view in three groups:—(1) In the *Banksia* group the vessels are arranged in concentric zones; (2) in the *Ozites* group they form incomplete arcs terminated by wings of woody parenchyme; (3) in the *Protea* group the vessels are dispersed irregularly through the woody fibres. In *Myrica* (Myricaceæ) the general structure is absolutely the same as in *Persoonia*. The secondary xylem of the Piperaceæ is composed of woody fibres in radial bands, among which the vessels are arranged in simple rows or in clusters; a similar structure occurs in the Chloranthaceæ and the Garryaceæ. In the Chenopodiaceæ the structure of the secondary xylem is subject to considerable variation. The Thymelacæ are characterized by the small number of vessels; the arrangement of these justifies the division of the order into the two groups generally adopted, the Aquilariacæ and the Thymeleæ. In the Polygonaceæ the structure of the secondary xylem is very uniform, the vessels are large and isolated, and are rarely accompanied by woody parenchyme. The Urticaceæ probably comprise plants of very various origin; two types may be distinguished, (1) the Urticoideæ characterized by broad transverse bands of woody parenchyme at the level of the vessels; (2) the Ulmoideæ in which the woody parenchyme is wanting, or but slightly developed.

Stem of Phaseolus Caracalla.†—Prof. A. Borzi describes an anomaly in the structure of the stem of this plant. It consists chiefly in the unlimited production of phloem-bundles of a tertiary character, which insert themselves between the elements of the secondary xylem. Other Leguminosæ—*Abrus precatorius*, *Wistaria chinensis*, *Rhynchosia phaseoloides*, *Pueraria Thunbergiana*, the species of *Bauhinia* of the section *Caulotretus*—present the anomaly of the production of tissues of a tertiary character from the activity of one or more supernumerary generating zones. The peculiarity of *Phaseolus Caracalla* is the production of tertiary bundles of an exclusively phloem-character, while the cambium retains its normal activity.

Sieve-tubes in the Xylem.‡—Prof. R. Chodat discusses the origin of the sieve-tubes which occasionally occur in the xylem of woody plants, especially in reference to two species of *Dicella* from Paraguay, belonging to the Malpighiaceæ. He states that the origin of these sieve-tubes varies. In *Dicella* and *Atropa* they belong to the xylem-region, and are formed on the inner face of the cambium-zone. In *Strychnos*, on the other hand, they appear on the outer face of a generative arc, the activity of which ceases at the end of a certain time, while an adventitious arc is formed at the periphery. In *Dicella* the generative layer often produces at the same time sieve-elements on both the inner and outer faces by centripetal and centrifugal septation. The

* Comptes Rendus, cxiv. (1892) pp. 953-5.

† Malpighia, v. (1892) pp. 372-85 (2 pls.).

‡ Arch. Sci. Phys. et Nat., xxvii. (1892) pp. 229-39 (1 pl.). Cf. this Journal, 1891, p. 618.

author proposes the term "sieve-xylem" for these groups of sieve-cells in the xylem of *Dicella*, "phloem-islands" for those of *Strychnos*.

Obliteration of Sieve-tubes.*—According to Herr H. Bliesenick, the obliteration of sieve-tubes in the secondary cortex is always due to the pressure of mechanical elements. The partial obliteration of the tubes in the autumn by the formation of callus is always again neutralized when the sap begins to flow in the spring; the sieve-pores are quite open at the time of expansion of the first leaves. When the sieve-elements are closed, the tissue sometimes assumes a horny consistency, forming what the author terms *ceratenchyme*.

According to the mode in which the obliteration takes place, the author distinguishes four types in dicotyledonous trees, viz. :—(1) The bast-fibres are arranged in radial rows in such a way that the sieve-elements lying between them are only slightly obliterated, or not at all. (2) The bast is arranged in tangential rows of variable strength, and is often accompanied by sclerenchymatous cells; the bast-fibres take various forms for the purpose of protecting the sieve-elements; *ceratenchyme* is usually formed, with obliteration of elements. (3) The bast-fibres are very weak or entirely wanting; there is a greater or less development of sclerenchymatous cells. (4) Neither bast-fibres nor sclerenchymatous cells are formed in the secondary cortex. A number of illustrations are given of each type.

Formation of Cork.†—Herr J. E. Weiss designates as *phelloid-cells* those which are separated on the outer side from the phellogen, but which are not themselves suberized. The formation of such cells is frequent, but is generally characteristic of particular families or sections. Their formation within cork can only take place when the initial cells of the cork are imbedded deep in the primary or secondary cortex. The various modes in which this may occur are described in detail. The cork-cells may subsequently divide again by a radial wall. In many plants the cork-cells are indistinguishable from the cells of the protecting sheath, and undergo at a later period similar changes. When lying isolated between two cork-cells, there are often intercellular passages. Cork is frequently formed even in annual plants. Its cells are always formed in centripetal succession, while the cells of the phelloderm are always formed centrifugally.

The value of the mode of formation of cork for systematic purposes is then discussed in detail, the most important point being the region where the cork begins to be formed.

Histological Structure of Carex.‡—Herr A. Mazel has examined the structure of forty-three species of *Carex*, especially on two points, the stomates, and the vascular bundles of the rhizome and root. He finds the differences to correspond with the habit of the species rather than with characters which can be used in classification. The stomates are

* 'Ueb. d. Obliteration d. Siebröhren,' Erlangen, 1891. See Bot. Centralbl., xlix. (1892) p. 274.

† Denk-chr. K. Bayer. Bot. Gesell. Regensburg, vi. (1890) 69 pp. and 1 pl. See Bot. Centralbl., i. (1892) p. 88.

‡ 'Études d'anat. comp. s. l. organes de végétation dans le genre *Carex*,' Genève, 1891, 213 pp. and 7 pls. See Bot. Centralbl., 1891, Beih., p. 514.

superficial in the species which inhabit dry, depressed in the tissue of those which inhabit boggy situations. In *C. arenaria* and other species with a similar habit, the mechanical elements are but feebly developed in the root; while in the aquatic species we find a strongly developed peripheral ring of sclerenchyme, and a thick-walled endoderm usually consisting of three or four rows of cells.

Anatomy of the Tubifloræ.*—Herr G. von Schlepegrell describes in great detail the comparative anatomy of the natural orders belonging to the Tubifloræ, comprising the Hydrophyllaceæ, Borragineæ, Polemoniaceæ, Solanaceæ, Nolanaceæ, and Convolvulaceæ, especially with a view to the classification of the genera.

The Hydrophyllaceæ are divided into the Hydrophyllæ, in which the vascular bundles are isolated, and are surrounded within and without by thick-walled unligified tissue; and the Phaceliæ, Nameæ, and Hydrolæ, which have the vascular bundles arranged in a closed ring; the last tribe is provided with large air-canals in the cortical tissue, which are wanting in the first two. The genera of Polemoniaceæ are classified according as the secondary vessels are large (*Cobæa*), or small; in the latter case all the vessels are either collected into groups (*Bonplandia*), or dispersed through the xylem (*Phlox*, *Collomia*, *Gilia*, *Polemonium*, *Læselia*, and *Cantua*). The Borragineæ are divided into two principal groups; in the Borragæ there are no outer bast-fibres; in the Cordiæ, Ehretiæ, and Heliotropiæ, the outer bast-fibres form a more or less distinct ring. In the Convolvulaceæ the anatomical structure is not of itself sufficient to establish a satisfactory classification of the genera. In the Nolanaceæ the bast-fibres form radial rows in *Alona* and *Nolana*, but not in *Dolia* and *Bargemontia*. Among the Solanaceæ, there is no inner phloem in *Retzia* and *Lonchostoma*, while there is in the other genera of the order, which may be distinguished from one another by the nature of the hairs.

Of the genera the position of which is doubtful according to Bentham and Hooker, *Amerina* is referred to Verbenaceæ, *Pseudopyxis* to Rubiaceæ, *Sclerophyllax* and *Calibrachoa* to Solanaceæ, *Heteranthia* and *Leucophyllum* to Scrophulariaceæ, *Doræna* to Myrsinaceæ, *Isanthera* to Gesneraceæ.

Anatomy of Eriocaulaceæ.†—From an examination of three genera and fifteen species of Eriocaulaceæ, Herr V. A. Poulsen regards them, from an anatomical point of view, as typical Monocotyledons. The fissure of the stomates is exceedingly narrow, but in other respects they resemble those of Gramineæ and Cyperaceæ. The fibrovascular bundles represent a special type, which the author calls "biconcentric." Round the axial hadrome-bundle is a layer of leptome, which is again inclosed by a hadrome-layer.

Influence of Traction on the Firmness of Plants.‡—Prof. W. Pfeffer describes a series of experiments made by R. Hegler on the increased strength and development of the mechanical tissues of plants resulting

* Bot. Centralbl., xlix. (1892) pp. 193-200, 225-31, 257-63, 289-99, 353-60, 385-93; l. (1892) pp. 1-7, 33-9 (4 pls.).

† 'Anat. Unters. üb. d. Eriocaulaceæ,' 166 pp. and 7 pls., Copenhagen, 1888. See Bot. Centralbl., 1892, Beih., p. 34.

‡ Ber. Verhandl. K. Sächs. Gesell. Wiss., v. (1892) pp. 638-43.

from the application of the dragging force of strings stretched over rollers and weighted. The hypocotyl of a seedling sunflower which was ruptured by a weight of 160 grm., bore a weight of 250 grm. after being subjected for two days to the strain of a weight of 150 grm.; after a few days the weight was increased to 300 or 400 grm. without injury. Seedlings of *Phaseolus* which were ruptured by a weight of 180 grm. could, after seven days, resist a strain of 650 grm. after being subjected to one of 165 grm. Leaf-stalks of *Helleborus niger* (Christmas rose), with a limit of resistance amounting to about 400 grm., were able to resist one of 3·5 kil. after about five days. Similar increase in firmness was demonstrated in other stems and in tendrils, as well as in the case of etiolated plants. The increase in strength is effected by a strengthening of the cell-walls, generally accompanied by a great increase in the collenchyme. Bast-fibres already in existence are greatly strengthened, and they may be called into existence where they do not previously occur, as in the leaf-stalk of *Helleborus niger*. The strengthening of the mechanical elements is accompanied by a retardation of the growth in length.

(4) Structure of Organs.

Hairs on the Corolla of *Pinguicula*.*—Prof. A. Weiss describes the capitate hairs in the throat of the corolla of *Pinguicula vulgaris*, which he states to have no secreting function, but to be probably connected with the fertilization of the flower through the agency of insects. When mature all of the numerous cells of which the hair is composed, with the exception of the basal one, are strongly cuticularized, the cuticularization taking the form of interrupted spiral bands. Intermediate between the cells which form the pedicel and those which form the head, is usually an intermediate cell containing, like the head, a yellow fluid, while the cells of the pedicel contain a violet fluid; both, however, disappearing in old hairs. The head may consist of a single globular cell, or may be divided into a number of cells. Each hair originates from a single epidermal cell; the pedicel-cells are always formed first, the head being a later production. All the cells of the hair contain abundance of protoplasm, which is in active rotation.

Dorsal Position of Ovules in Angiosperms.†—M. G. Chauveaud states that in the Asclepiadæ (*Vincetoxicum officinale*) the ovules are produced on two placental wings which, from a morphological point of view, occupy the inferior or dorsal face of the carpellary leaves. He considers that this tends to break down the essential difference which has hitherto been supposed to subsist between Gymnosperms and Angiosperms, in the ovules being borne in the former on the inferior, in the latter on the superior face or margins of the carpels; also that there is a more complete homology than had previously been supposed between the male and female organs in Angiosperms.

Classification of Fruits.‡—M. G. Beauvisage proposes a classification of the various kind of fruit into the four divisions of berry, drupe

* SB. K. Akad. Wiss. Wien, c. (1891) pp. 276-83 (1 pl.).

† Comptes Rendus, exiv. (1892) pp. 141-3.

‡ 'Remarques s. l. classification des fruits,' 74 pp. and 1 pl., Lyon. See Bonnier's Rev. Gén. de Bot., iv. (1892) p. 188.

(including samara and caryopsis), achene, and capsule. Capsules are again divided into two groups, according as they dehisce by longitudinal fissures or not. In each group subdivisions are established according to the number of carpels, the placentation, and the mode of dehiscence.

Integument of the Seed of Papaveraceæ.*—M. A. Meunier has investigated the structure and history of development of the integument of the seed in the Papaveraceæ, in which order he includes the Fumariaceæ. In the Papaveræ the ovules are almost always anatropous, while in the greater number of the Fumariæ they are campylotropous. The structure of the integument is, however, the same in both suborders, both as regards the ovule and the mature seed. The spermoderm is differentiated into several layers of cells, the most important variations in structure being due to the different forms of the ovule. The double endosperm is identical in its structure, its origin, and in the nature of its contents, throughout the order.

Integument of the Seed of Euphorbiaceæ.†—Herr G. Kayser has examined the structure of the seed and the development of its integument in *Ricinus communis* and in other Euphorbiaceæ. The seed of *Ricinus* is characterized by the remarkable development of the chalazal tissue, which does not occur in other genera of the order. The ovule of *Croton flaveus* has only a single integument, corresponding to the outer integument of *Ricinus*.

Seeds of Umbelliferæ.‡—From the examination of the seeds of a considerable number of species belonging to this natural order, Herr G. Kayser concludes that in the course of their development all the layers of the original integument disappear except the outermost. This, which becomes the testa of the mature seed, is in immediate contact with the inner epiderm of the pericarp; and the two together have the appearance of constituting a testa composed of two layers. The original nutrient stratum of the integument of the ovule, which becomes subsequently resorbed, consists, in all cases examined by the author, of several layers of cells.

Seed-coats of Malvaceæ.§—Mr. P. H. Rolfs has examined the changes which take place in the course of development of the seed-coats in 22 genera and 34 species of Malvaceæ. These are described in detail in the case of several species. The general structure of the coats in the order is very characteristic; there are minor differences only in the different species of the same genus, and non-essential variations in the different genera.

Seeds of Hemerocallis.¶—Dr. E. Baroni states that in the ripe seeds of *Hemerocallis flava* there is an inner integument resulting from the secundine of the ovule. The spermoderm (testa) consists of eight or ten layers of large cells. These are arranged in three strata, of which the outermost is of a light violet colour, the middle one nearly black, while the innermost shows a gradation of colour from black to reddish yellow.

* La Cellule, vii. (1891) pp. 375-413 (2 pls.). Cf. this Journal, 1891, p. 367.

† Ber. Pharm. Gesell., ii. (1892) pp. 5-19. See Bot. Centralbl., l. (1892) p. 14.

‡ Ber. Pharm. Gesell., i. (1891) pp. 157-62. See Bot. Centralbl., xlix. (1892) p. 315.

§ Bot. Gazette, xvii. (1892) pp. 33-9 (1 pl.).

¶ Bull. Soc. Bot. Ital., i. (1892) pp. 61-5.

Wings of the Seed of Abietinæ.*—Dr. K. von Tubeuf states that in all Abietinæ, except some species of *Pinus*, the wing protects the young seed wherever the seed is not coalescent with the scale. In all the coniferous Gymnosperms the seed is as much protected as it would be by an ovary, either by a parenchymatous structure formed of conical papillæ, or by a dense felt of hairs formed on the margin of the scales.

Arils.†—Herr A. Pfeiffer classifies arils into three groups, according to their origin:—(1) From the funicle and its various regions, the hilum, the chalaza, and the raphe (*Mucuna*, *Cytisus*, Passifloraceæ, &c.); (2) from the exostome (Euphorbiaceæ, Polygalaceæ, &c.); (3) from the tissues comprised between the funicle and the exostome (*Myristica*, *Celastrus*, *Euonymus*, &c.). From an anatomical point of view the aril, whether soft or resistant, is almost without exception parenchymatous; in the former case the cells have thin, in the latter case more or less thick walls. They usually contain abundance of nutritive matter, of the same kind as that contained in the seed. In some cases (Myristicaceæ, Connaraceæ, &c.) the aril is traversed by small vascular bundles derived from those of the placenta. It is probable that arils frequently facilitate the dispersion of the seeds, especially when they are winged or fleshy; others contain a transitory store of food-material, which is afterwards used up in the ripening of the seed.

Rhizome and Inflorescence of Paris.‡—M. H. Hua describes in detail the structure of the rhizome of *Paris quadrifolia*, and the mode of formation of the buds upon it. He asserts the mode of branching to be sympodial, similar to that of *Polygonatum*. The inflorescence may be regarded as an indefinite raceme, in which the greater part of the flowers abort before attaining complete development, and of which one only develops in each year.

Casting-off of Hairs.§—Herr R. Keller has investigated the structure of the hairs, and the mode in which they are thrown off, in a large number of Phanerogams and a few Vascular Cryptogams. The throwing-off of the hairs is generally accompanied by more or less suberization, and, according to the way in which this is effected, hairs may be classified under four types,—(1) Unicellular hairs which break off near the epiderm leaving behind a suberized foot (*Juglans*, *Fagus*, *Ficus*, &c.); (2) Uniseriate hairs with a well-marked terminal cell, which is elongated in the direction either of the base or of the surface, or is stellate; the terminal cell separates from the base (Myrtaceæ, Papilionaceæ, Proteaceæ, Pittosporæ, &c.); (3) Uniseriate hairs (or branched in one row) in which a varying number of basal cells are suberized and the rest thrown off (*Marsilea*, *Platanus*, *Nuphar*, *Nymphæa*, *Ficus*, &c.); (4) Multiseriate hairs (*Vitis*, *Quercus*, *Elæagnus*, *Begonia*, *Lomaria*, *Acrostichum*, &c.). The fall of hairs is brought about partly by internal, partly by external causes, the latter being the more constant;

* SB. Bot. Ver. München, March 14, 1892. See Bot. Centralbl., l. (1892) p. 73.

† Engler's Jahrb. d. Systematik, xiii. (1891) pp. 492-540. See Bonnier's Rev. Gén. de Bot., iv. (1892) p. 191.

‡ Journ. de Bot. (Morot) vi. (1892) pp. 161-6.

§ Nova Acta Acad. Cæs. Leop.-Carol. Nat. Cur., lv. (1891) pp. 305-58 (3 pls.).

the incidence of strong light appears to be the most important factor. The mode of falling off often differs greatly in nearly allied species. The whole of the hair is never completely thrown off; a rudiment always remains behind.

Formation of Balls of Roots.*—Prof. J. Sachs discusses the “balling” of the roots of plants grown in pots or wherever the supply of soil is insufficient. It depends on the excessive lengthening and ramification of the root-filaments, without any correspondingly large development of root-hairs. The injurious effect of this balling on the growth of the plant is due partly to the interference with respiration, caused by the crowding of the roots; partly to the insufficient supply of nutriment consequent on the difficulty with which water penetrates through the dense mass of roots; but chiefly to the fact that the root-hairs are prevented from coming into contact with the particles of soil on which they are dependent for their nutriment.

Roxburghia.†—Herr V. Lachner-Sandoval has exhaustively examined the structure of several species belonging to this genus. In *R. javanica* he finds that the arrangement of the parts of the flower is such as to facilitate self-pollination, and to render cross-pollination very difficult. In the embryo-sac no antipodals could be detected. One of the synergidæ frequently increases in size along with the fertilized oosphere, and clothes itself with a cell-wall. The author sees no sufficient ground for maintaining the Roxburghiaceæ as a distinct group from the Liliaceæ. Their one distinguishing character is the monocarpellary pistil. The basal placentation is a peculiarity of the genus *Roxburghia* alone.

β. Physiology.

(1) Reproduction and Embryology.

Embryogeny of Gnetum.‡—Herr G. Karsten has studied the processes which go on within the embryo-sac in the East Indian species of *Gnetum*, viz. *G. Gnemon*, *neglectum*, and *edule*, and three undescribed species, and compares them with the corresponding phenomena in *Casuarina*, as observed by Treub.§ Sections of the female flowers were made by Jung’s microtome, and coloured by picro-carmin.

The inner integument of the ovule develops into a long tube leading to the apex of the nucellus, and projecting far beyond the other two integuments; this forms at its apex a drop of sweet fluid which captures the pollen-grains carried by the wind or possibly by insects. The outer very thick integument becomes fleshy and bright-coloured, and is attractive to herbivorous animals. In the division of the cells of the nucellus at an early stage, there is no evident predestination of one, as there is in most Angiosperms, to be the mother-cell of the embryo-sac. In *G. Gnemon* and *neglectum* there are usually two, three, or even more embryo-sacs which appear equally capable of further development; while in *G. edule* and allied forms only one was seen. In the division of the contents of the embryo-sac (in all the species examined)

* Flora, lxxv. (1892) pp. 171–82.

† Bot. Centralbl., l. (1892) pp. 65–70, 97–104, 129–35 (1 pl.).

‡ Bot. Ztg., l. (1892) pp. 205–15, 221–31, 237–46 (2 pls.).

§ Cf. this Journal, ante, p. 230.

no differentiation of female apparatus takes place; no corpuscles or special egg-cells are formed, nor any antipodals; the protoplasm of the embryo-sac divides into a parietal layer of primordial cells (with central vacuole), which appear to be altogether equivalent, and which represent so many egg-cells capable of impregnation.

The course of the pollen-tube is easily followed. Its nucleus probably gives off a smaller vegetative nucleus soon after its entrance into the tissue of the nucellus. The two nuclei continue very near to one another; while the vegetative nucleus or prothallium-cell remains unchanged, the generative nucleus increases greatly in size, and divides into two of equal value; the apex of the pollen-tube has now (in *G. edule*) entered the apex of the embryo-sac; while in *G. neglectum* it appears to make a curve to avoid the apex of the sac, and becomes closely applied to its lower part. The micropyle closes after impregnation. After the pollen-tube has entered the embryo-sac, its vegetative nucleus disappears, while each of the two generative nuclei surrounds itself with a protoplasmic membrane, and the nucleus in each generative cell divides into four or possibly into eight. The author was unable to detect the actual coalescence of the male and female nuclei; but in the male generative cells, in addition to the four comparatively large male nuclei, a number of small nuclei were detected, which the author regards as the nuclei of the primordial egg-cells which have wandered into the male generative cells; and the coalescence must take place within the male generative cell.

After the entrance of the pollen-tube the parietal layer of protoplasm of the embryo-sac in which the female primordial cells are imbedded, breaks up into an endosperm tissue; and the central vacuole also becomes replaced by the endosperm, which is wanting only in the parts occupied by the male cells or the resulting embryos.

The development of the embryo is described in detail, including the formation of a pro-embryo or suspensor. Although there is such large scope for poly-embryony, the author found no example of more than one embryo becoming fully developed.

Very little is known of the corresponding processes in the other genera of Gnetaceæ, *Welwitschia* and *Ephedra*. The author regards *Gnetum* as representing the highest type of the order; the fact that no endosperm is formed before impregnation is an advance on other Gymnosperms. The presence of a large number of fertile embryo-sacs, and the absence of antipodals, indicate some analogy with *Casuarina*.

Herr Karsten holds that the processes described above finally negative the theory that the antipodals are a survival of the prothallium of Vascular Cryptogams; he regards them rather as a degenerate and functionless female sexual apparatus. According to this view there are, in the embryo-sac of Angiosperms, two sexual apparatuses, of similar origin, the vegetative nuclei of which coalesce, but one of which is altogether abortive. Both antipodals and egg-apparatus (embryonic vesicles) consist of an archegone reduced to a single cell.

Embryogeny of Tectona.*—Herr S. H. Kooders describes in detail the mode of development of the embryo of *Tectona grandis* (Verbenaceæ),

* Natuurk. Tijdschr. Nederl. Indie, li. (1891) 8 pls. See Bot. Centralbl., xlix. (1892) p. 271.

the "djati-tree" of Java. After the first formation of the embryo and suspensor, the embryo-sac undergoes constriction* into a long slender upper portion and a short ovoid lower portion, the latter containing the embryo and suspensor, the apex of which sometimes penetrates the upper portion. The endosperm is differentiated into an upper and a lower portion. The former is composed of a small number of moderately large very irregular cells, with very thin walls, containing large oil-drops and inconspicuous nuclei. The lower endosperm is composed of much smaller tolerably regular globular or polyhedral cells with thicker walls, and a hyaline protoplasm containing very small oil-drops and large conspicuous nuclei. Both portions of the endosperm are subsequently almost entirely resorbed, only a very thin layer remaining in the mature seed. Along with the suspensor there are developed a number (10-20) of vesicular endosperm-cells, which apparently serve to convey the nutrient material from the rest of the endosperm to the suspensor, from which it reaches the embryo. They disappear along with the suspensor.

Starch was but seldom found in the embryo, and the author is of opinion that the outer cells of the upper endosperm have the faculty of transforming both starch and sugar into oil. This transformation takes place chiefly at the boundary of the upper and lower endosperm, whence it is conveyed, through the lower endosperm, to the vesicles, the suspensor, and finally to the embryo.

Ovule and Embryo-sac of Vincetoxicum. † — M. G. Chauveaud describes the peculiarities in the structure of the ovule of *Vincetoxicum officinale*. He reverts to the earlier view, in opposition to that of Warming, that the nucellus is entirely naked, without integument. A single hypodermal cell of the original papilla which constitutes the ovule develops directly into the embryo-sac without undergoing any division, a process which has not been observed before in dicotyledons. Strictly speaking the whole of the tissue beneath the epiderm, that is, the whole of the nucellus, is reduced to an embryo-sac. As this cell grows it inserts itself between the four epidermal cells which surround it; these separate from one another; and the space thus formed is the origin of the micropylar canal.

Cleistogamous Flowers of Polygonum. ‡ — Prof. S. Coulter finds cleistogamous flowers on a large number of species of *Polygonum*, including the British species *P. Hydropiper*, *lapathifolium*, *maritimum*, and *Persicaria*. In *P. Hydropiper* they are particularly abundant. The cleistogamous flowers are especially produced late in the season, are completely concealed by the sheath, and appear invariably to ripen their achenes.

Mr. T. Meehan § finds cleistogamous flowers to be exceedingly common in *P. acre*; they are apparently invariably fertile and are of a special kind found in no other species, small white flowers hidden beneath the ochrea of the leaf.

* Cf. this Journal, *ante*, p. 232.

† Comptes Rendus, cxiv. (1892) pp. 313-5.

‡ Bot. Gazette, xvii. (1892) pp. 91-2. Cf. this Journal, *ante*, p. 232.

§ Proc. Acad. Nat. Sci. Philadelphia, 1892, pp. 163-4.

Evolution in Methods of Pollination.*—Miss A. Carter discusses the different modes of pollination in Flowering Plants, and the way in which they have been evolved. She points out that the most ancient forms, the Gymnosperms, are all anemophilous. Of the Monocotyledones, which are older than the Dicotyledones, five out of the twenty-two American orders, the Cyperaceæ, Gramineæ, Juncaceæ, Eriocaulaceæ, and Typhaceæ, are entirely anemophilous; while others, as *Vallisneria* and many Naiadaceæ, are hydrophilous. Of the twenty-three natural orders in the whole world which comprise more than 1000 species, five are characterized by inconspicuous flowers. Of these, four, viz. the Cyperaceæ, Gramineæ, Urticaceæ, and Piperaceæ, are probably ancestral types; the fifth, Euphorbiaceæ, degenerate. It may be assumed that the period of the appearance of Dicotyledons was also that of the development of our great groups of insects. The first step towards the attraction of insects was probably the colouring of the stamens, as in *Plantago* and *Thalictrum*; the colouring of the corolla and the development of saccharine secretions was a subsequent adaptation. The most highly developed orders appear to be those in which the number of parts in a floral whorl is small, as the Compositæ, Umbelliferae, Leguminosæ, Orchideæ, Labiatae, Scrophulariaceæ, Rubiaceæ, Ericaceæ, &c.

In another paper † Miss Carter gives details regarding the mode of pollination of some American plants.

Pollination of *Dracunculus*.‡—Sig. P. E. Vinassa finds that *Dracunculus vulgaris* is pollinated by coleoptera (*Dermestes*, *Saprinus*, *Carabus*, *Oxythyrea*, &c.), and that flies enter only exceptionally, and are ineffective. When the anthers are exposed the fragrance has ceased, and flies are no longer attracted to the inflorescence.

Prof. G. Arcangeli § also records further observations which show that necrophagous coleoptera are truly and mainly the pollinators of this species.

Dracunculus canariensis, which emits, when the flowers are expanded, a powerful odour something between that of melon and of pine-apple, is, on the contrary, according to Prof. Arcangeli,|| habitually self-pollinated. This does not, however, exclude the possibility of occasional cross-pollination, and the visiting insects appear to be necro-coleoptera.

Pollination of Pyrenæan Flowers.¶—M. J. M'Leod describes the mode of pollination of 261 species of flowering plants natives of the Pyrenees up to a height of 2200 metres, and compares the relative frequency of the different types of flower-visiting insects with that in the Alps. As a general rule Lepidoptera are less abundant, insects with a short or moderately long proboscis more abundant, in the Pyrenees than in the Alps; but otherwise there is no great difference in the general facts, nor in the relative number of species belonging to the different groups of insects found at different heights.

* Bot. Gazette, xvii. (1892) pp. 40-6, 72-8.

† Tom. cit., pp. 19-22.

‡ Atti Soc. Tosc. Sci. Nat., vii. (1891) pp. 317-9.

§ Tom. cit., pp. 332-4; and Malpighia, v. (1892) pp. 426-8. Cf. this Journal, 1891, p. 68.

Bull. Soc. Bot. Ital., i. (1892) pp. 87-91.

¶ Bot. Jaarb. kruitk. Genootsch. Dodonæa, Gent, III., pp. 160-485 (5 pls.). See Bot. Centralbl., xlix. (1892) p. 142.

Pollination of *Nigella*.*—Dr. A. Terracciano describes the floral structure in several species of *Nigella*, especially *N. damascena*, *sativa*, *Bourgaei*, *feniculacea*, *arvensis*, and *gallica*, and concludes that, notwithstanding the conspicuous flowers, and the presence of nectaries, the flower is adapted for self-fertilization.

(2) **Nutrition and Growth (including Germination, and Movements of Fluids).**

Germination of *Araucaria Bidwilli*.†—Prof. E. Heckel describes a mode of germination of the seeds of this species which appears to be quite peculiar to it. The hypocotyl swells into a large fusiform tubercle, which rapidly attains a length of from 4 to 5 cm., terminating in the root. This tubercle remains adherent to the gemmule, and the endosperm gives up to it its reserve food-materials, under the absorbing action of the green cotyledons. The ordinary mode of propagating this species of *Araucaria* is by means of the tubercles which have developed on seeds that have already germinated.

Dissemination of Seeds.‡—Herr J. Verschaffel states that in *Salvia Horminum* and *lanceolata* the seeds are set at liberty only under the influence of rain or moisture, the two lips of the calyx, which are closed when the air is dry, then separating. Moreover, the pedicel of the fruit is curved downwards when dry; when the air is moist it straightens itself so that the fruits escaping from the open calyx fall at some distance from the plant. In *Iberis umbellata* the pedicels of the ripe fruits are pressed against one another when the air is dry, and separate only under the influence of moisture, or when they are softened by rain, thus facilitating their dispersion by the wind or by animals. This is not the case with *I. amara*.

Period of Formation of the Flower.§—In support of his theory that the substances which go to the formation of the flower are already formed in the green leaves, Prof. J. Sachs describes the following experiments. Leaves of a *Begonia* gathered at the end of May were propagated in the ordinary way on wet sand. Numerous buds were formed in the course of a few weeks; but it was only after they had grown to the size of vigorous plants, early in November, that inflorescences were first produced in the axils of later leaves. On the other hand, when the leaves were gathered from flowering plants at the end of July, and propagated in the same way, the buds first formed contained inflorescences which blossomed in October, and which were borne in the axils of the oldest leaves of the bud. They must therefore have been formed in the very youngest condition of the bud. Prof. Sachs draws from these facts the conclusion that the substances which are used up in the formation of the flowers are present in the leaves in the summer, but not in the early spring.

Development of the Male Inflorescence of the Walnut.||—According to M. W. Russell, the male catkins of the walnut begin to be formed

* Bull. Soc. Bot. Ital., i. (1892) pp. 46-50.

† Comptes Rendus, cxiii. (1891) pp. 816-8.

‡ Bot. Jaarb., 1890, pp. 148-56; 1891, pp. 95-109 (2 pls.). See Bonnier's Rev. Gén. de Botanique, iv. (1892) p. 192.

§ Flora, lxxv. (1892) pp. 1-3.

|| Rev. Gén. de Bot. (Bonnier) iv. (1892) pp. 18-21.

about the end of April, at the expense of their subtending bract, and are fully developed by the July preceding their blossoming. The female flowers, on the other hand, make their appearance on twigs which are formed in the spring, and the whole of their development is accomplished in the same year. They are, therefore, fecundated by the pollen of male flowers formed at a very much earlier period. By the month of July the catkin is about a centimetre in length, and the pollen-sacs are then already formed, although the pollen-grains are not fully differentiated until the moment of flowering.

Viviparous Grasses.*—According to Herr J. H. Wakker, the phenomenon of viviparity may occur either in the upper part only of the spike, or in both the upper and the lower part. Viviparous growth appears to take place almost entirely in the autumn, and to be dependent on a large supply of animal manure to the soil, which promotes the development of the vegetative organs, while it is unfavourable to the formation of flowers.

Activity of the Cambium in Trees.†—With the view of determining the period of the annual reappearance and extinction of the activity of the cambium-ring, M. E. Mer has made a series of observations on a number of dicotyledonous and gymnospermous trees—the oak, beech, hornbeam, lime, poplar, fir, &c. He finds an obvious relation between the duration and the intensity of the activity of the cambium. It is in the regions of the trunk where the vegetative activity is most pronounced—whether because they are the younger or because they receive the most nutriment—that the cambium first wakes into activity, viz. in the extremities of the branches, in the basal swellings of the boughs, in the lower part of the trunk of vigorous trees. Under all conditions, on the other hand, where vegetation is retarded, the activity of the cambium begins later and ceases earlier, as in the lower parts of the branches and of the trunk of trees which are massed together. In young trees, especially when they are crowded together, the annual rings of wood are often broader in the middle and upper than in the lower part of the trunk; while in older isolated trees, especially during the period of most rapid growth, the breadth of the rings gradually increases from above downwards, showing a great activity of the generating layer in this latter region.

Assimilation of Free Nitrogen by Plants.‡—Herr B. Frank recurs to the subject of the power of leguminous plants to absorb free nitrogen directly from the atmosphere, and details the results of a series of experiments, chiefly on *Lupinus luteus* and *Pisum sativum*. He found that, even when the presence of a symbiotic fungus is excluded, both these plants can obtain their nitrogen from nitrogenous manures, calcium nitrate, ammonium phosphate, or urea; but that the symbiotic fungus alone, without these manures, is more favourable to the plant than the manures without the fungus. The pea is more dependent on the nitrogenous manure than is the lupin. In good soils both these plants have

* SB. Niederl. Bot. Ver., Feb. 7, 1891. See Bot. Centralbl., xlix. (1892) p. 142.

† Comptes Rendus, cxiv. (1892) pp. 242-5.

‡ Deutsche Landwirthsch. Presse, 1891, pp. 779-80. See Bot. Centralbl., 1892, Beih., p. 71. Cf. this Journal, ante, p. 234.

the power of absorbing free nitrogen directly from the atmosphere without the assistance of the symbiotic fungus. In soil containing but little nitrogenous substance, the lupin is almost entirely dependent for its sustenance on the fungus. *Trifolium pratense* behaves in almost exactly the same way as the pea. Hence the yellow lupin is an exceedingly valuable plant for increasing the nitrogenous contents, and in consequence the productiveness, of a poor soil. The author, therefore, contests the statement of Hellriegel* that leguminous plants are entirely dependent on the symbiotic fungus for obtaining their supply of nitrogen from the air.

Herr Frank also states that some plants not belonging to the Leguminosæ, as the oat, buckwheat, asparagus, rape-seed, &c., have the same faculty of obtaining free nitrogen from the atmosphere, without the assistance of a symbiotic fungus, and hence of increasing the nitrogenous constituents of the soil.

Sources of Nitrogen in Leguminous Plants.†—The most recent experiments of Sir J. B. Lawes and Dr. J. H. Gilbert show that the nodule-bacteria of Leguminosæ have no power of fixing free nitrogen while in the soil, but only when carrying on a symbiotic existence in the roots of the plant. They may, however, bring the organic nitrogen into an available form, as in the case of mycorrhiza and of the fungus of fairy rings. The free nitrogen appears to be fixed in the course of development of the organisms within the nodule. A good deal of the nitrogen of leguminous crops is also taken up in the form of nitrates. The experiments further show that soil which is quite exhausted as far as the growth of one leguminous crop is concerned, may grow very luxuriant crops of another species even of the same family. The authors give a *résumé* of the observations of previous observers. Thus, while experiments with yellow lupins gave very striking results, those with blue lupins entirely failed. *Gleditschia*, which belongs to the suborder Cæsalpiniceæ of Leguminosæ, proved altogether indifferent to infection from the nodule microbes.

Transpiration and the Movement of the Stomates.‡—Prof. A. Aloï, replying to the criticisms of Baccarini, repeats the conclusions to which his own observations have led him, viz. that a larger amount of transpiration always corresponds to a larger opening of the stomatic fissure; that a smaller amount of transpiration always corresponds to a narrowing or to a complete closing of the fissure; that the action of light has no effect in causing the opening of the stomate when the necessary moisture is wanting in the soil; the stomates regulate transpiration by their movements.

Tension of Gases in the Stem.§—Herr K. Pappenheim describes an elaborate apparatus for determining the tension of gases contained within the alburnum of Conifers (*Abies excelsa*). The following is a summary of the more important results at which he has arrived:—The air contained within the alburnum which was not under the immediate

* Cf. this Journal, 1889, p. 781.

† Journ. R. Agric. Soc., ii. (1892) pp. 657-702. Cf. this Journal, 1890, p. 634.

‡ Malpighia, v. (1892) pp. 419-26.

§ Bot. Centralbl., xlix. (1892) pp. 1-10, 33-40, 65-74, 97-106, 161-8 (1 pl.).

influence of the transpiration of the leaves showed a nearly uniform tension of from $\frac{3}{4}$ to $\frac{4}{5}$ atmospheric pressure. The water in the interior of the tracheids did not form an uninterrupted column from the base to the summit of the stem; the masses of water were separated from one another by bubbles of air. From the communication between columns belonging to adjoining "Jamin's chains," masses of water occur, of limited size and number, interrupted only by the very permeable membranes of the bordered pits. Our knowledge of the physical properties of these membranes is not sufficient to enable us to form a satisfactory theory of the function of the bordered pits. The chemical composition of the imprisoned air could not be determined with certainty.

(3) Irritability.

Photometric Movements of Plants.*—Herr F. Oltmanns records a series of observations on the movements of plants, or of parts of plants, dependent on light,—those especially observed being *Volvox globator*, *Spirogyra*, *Vaucheria*, *Phycomyces nitens*, leaves of *Phaseolus*, *Robinia*, *Tropæolum*, &c. The phenomena of phototaxy he divides under two heads—"orthophototaxy" (*Volvox*, *Spirogyra*) and "plagiophototaxy" (movements of chlorophyll-bodies). By this latter term is meant the power of light to effect changes in position when falling at any angle between 0° and 90° . The phenomena of phototropism—i. e. positive or negative heliotropic movements—are, in the same way, classed as "orthophototropic" (*Vaucheria*, *Phycomyces*, shoots of flowering plants) and "plagiophototropic" (leaflets of *Robinia pseudacacia*, *Phaseolus multiflorus*, *Tropæolum majus*). For every plant or every organ of a plant there is an optimum intensity of light during the period of its active growth; and the object of all photometric movements appears to be to bring the plant or the organ under this optimum degree of illumination.

The author points out the remarkable resemblance between photometric and all other movements of irritability, such as the chemotactic, thermotropic, and hydrotropic. Movement occurs, in all these cases, only when there is considerable departure from the optimum on one side only of the organism or of the organ in question, or when on both sides there is a departure but in very different degrees.

Carpotropic Movement in *Trifolium subterraneum*.†—Dr. H. Ross describes the process by which, in this species, the young fruits become buried in the ground. As soon as the fertilization of the fertile flowers has been accomplished, the common peduncle of the inflorescence curves so as to bring to the surface of the soil the young fruits which are surrounded and protected by a ball of sterile flowers consisting only of an elongated and very hairy calyx. By the continued growth of the peduncle, accompanied by circumnutation, this ball buries itself in the soil, where the seeds ripen. The cause of these movements of the peduncles is negative heliotropism; they always tend to move away from the light. The flowers appear to be self-pollinated.

* *Flora*, lxxv. (1892) pp. 183–266 (1 pl.).

† *Malpighia*, v. (1892) pp. 304–11.

Movements of the Flower and Fruit of *Erodium*.*—Dr. R. Cobelli finds that from the period of the opening of the flower to the ripening of the seeds, there occur, in *Erodium gruinum*, movements of the calyx, of the upper part of the flower-stalk, and of the mericarps. The sepals, at first erect, afterwards open to a nearly horizontal position, and then again close after the petals have dropped. The upper portion of the flower-stalk goes through various movements, which facilitate the pollen reaching the stigma in the same flower. No pollinating insects were observed on the plant, and it appears to be self-fertilized. The column turns on its axis to the extent of about 90° , carrying with it the beaks of the mericarps which remain attached to the column by their apices. The mericarps ultimately become detached from the column with such force that their elasticity causes them to be thrown to a distance of as much as 50 cm. from the plant.

Movements of the Leaves of *Porlieria*.†—Sig. G. Paoletti describes in detail the structure of the leaves of *Porlieria hygrometrica* (Zygophyllaceæ), and the phenomena attending their periodical movements. The lower portion of each leaf-stalk is expanded into a "primary motor node," a swollen mass of tissue with from ten to fifteen transverse furrows, and each leaflet has also its "secondary motor node." In each primary motor node are conducting bundles and a conducting parenchyme.

The movements of the leaves are nyctitropic; there are no true hygrometric movements, as the specific name of the plant would seem to imply. In the same leaf all the leaflets pass from the diurnal to the nocturnal, and from the nocturnal to the diurnal position, at nearly the same time. The youngest leaves attain their position of fullest expansion about mid-day; all the others at from 7 to 7.30 A.M.

The cause of the nyctitropic movements in this, as in other plants, is the unequal stretching of the upper and under halves of the motor nodes, in other words, a periodical variation of volume in the cells of which the upper and under surfaces are composed; there is no question of an unequal growth, as in movements of nutation. The cause of this change of volume lies most probably in the protoplasm and in the osmotic properties of the cell-sap. The cells which display this property belong only to the outer portion of the cortical parenchyme, which constitutes therefore a motor system in each motor node; the inner portion of the cortical parenchyme, the central parenchyme, and the conducting bundles, constituting an axial passive system, which assists, by its flexibility, in the nyctitropic movements.

Photographic Representation of the Movements of Plants.‡—MM. Dewèvre and E. Bordage point out the inadequacy of Darwin's method of observing the movements of plants, and describe an apparatus of their own contrivance which combines a graphic and a photographic representation.

Observations made in this way on climbing plants (*Humulus Lupulus*, *Ipomœa purpurea*, *Convolvulus sepium*) showed that the movements of

* Nuov. Giorn. Bot. Ital., xxiv. (1892) pp. 59-64 (1 pl.).

† Tom. cit., pp. 65-91 (5 pls.).

‡ Rev. Gén. de Bot. (Bonnier), iv. (1892) pp. 65-78 (8 figs.).

nutations of a young stem resemble those of all non-climbing stems. They consist of a succession of more or less irregular circular or elliptical curves, varying every moment even in their direction, caused by the unequal lengthening of the zone of growth of the stem. In the case of *Ipomæa*, the authors were able to determine a distinct heliotropism. The violet and ultra-violet rays exercise a distinctly prejudicial influence on the unrolling of the stem. White light retards the growth both of climbing and of non-climbing stems.

A movement of circumnutation was distinctly determined in roots, and one more regular even than that of the stem. This is the case also with a number of aerial roots, such as those of Orchideæ, Aroideæ, and Bignoniaceæ.

The sleep-movements of a number of leaves were observed, both those in which the movement of the leaflets is an upward, and those in which it is a downward one. In both cases the movement is by no means an uninterrupted one, but consists of a number of alternate movements upwards and downwards, at first considerable, then much less pronounced; the former of these are termed by the authors movements of oscillation, the latter movements of trembling.

(4) Chemical Changes (including Respiration and Fermentation).

Urease.*—M. P. Miquel describes a new diastase which according to the nomenclature of Duclaux is called urease. This ferment is secreted by those bacteria capable of converting urea into carbonate of ammonia. Urease is obtained from peptonized bouillon cultivations to which 2-3 grm. per litre of carbonate of ammonia have been added. The ferment, isolated by filtration, is capable of converting 60 to 80 grm. of urea into carbonate of ammonia per hour. It is much more delicate than other known diastases, its efficiency being much impaired even at 50° in a few hours, and destroyed in a few minutes at 75°, though it will keep for weeks at a temperature of about 0°.

The author has cultivated about forty species capable of transforming urea into carbonate of ammonia. All of these cultivated in bouillon devoid of urea secrete this diastase, and he infers that the alkaline fermentation of urea is always due to its action.

On the action of this ferment is founded a method for the quantitative estimation of urea. If a vessel containing equal volumes of a urea solution and of bouillon impregnated with urease be kept at 50°, all the urea will be converted in two hours. If the alkalinity before and after this procedure be determined, this will give the amount of ammonia produced, and hence the quantity of urea present.

Cellulose-dissolving Enzyme.†—Mr. H. T. Brown has found, from experiments on various animals, pigs and horses, that the destruction of the vegetable cell-membrane during digestion is owing to its being dissolved in the stomach by a cytohydrolyst pre-existent in the grain before ingestion.

The author started from the fact that the cell-walls were observed to be breaking down before the gastric contents had passed through the

* Comptes Rendus, exi. (1890) pp. 397-9, 501-2.

† Journ. Chem. Soc., cccliii. (1892) pp. 352-64.

pylorus; hence, although the small intestine was known to possess the power of secreting hydrolysing enzymes, it was only necessary to examine the salivary and gastric juices. With saliva the results were purely negative, and consequently the dissolving action occurred in the stomach. Herein it might be occasioned firstly by the churning or mechanical action of the stomach, secondly by the natural gastric acids acting directly or indirectly, thirdly by a special enzyme secreted by the gastric mucosa, and fourthly by the action of micro-organisms. For various reasons all these foregoing causes were disproved, and in the end the author had to fall back upon the hypothesis that the food is self-digested under the influence of a cellulose dissolving a cytohydrolytic enzyme pre-existent in the grain before ingestion.

γ. General.

Defoliation of the Vine.*—M. A. Muntz has investigated the effects of stripping the leaves from the neighbourhood of the grapes, which has been carried out from time immemorial in many parts of France, especially the Gironde. He finds it to be uniformly unfavourable, whether in wet or in dry seasons. The direct action of the rays of the sun is, he affirms, not favourable to the production of sugar in the grape.

Composition of the Air contained within Seed-vessels.†—Sig. G. de Negri gives the following analyses of the air contained within the follicles of a species of *Gomphocarpus* (Asclepiadææ):—In immature follicles, CO₂ 9·88 per cent., O 16·59 per cent., N 73·53 per cent.; in mature follicles, CO₂ 3·48 per cent., O 23·15 per cent., N 73·37 per cent.

Absorption of Sodium Chloride by Plants.‡—From the result of a series of experiments on cress and radish, M. P. Lesage finds that sodium chloride is present in large quantities in the stem and root of these plants when the soil is watered with a solution of the salt, and that it is absorbed as such by the plant.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Histology of the Sexual Cells of Cryptogams.§—Herr P. Schottländer has repeated Auerbach's experiments|| on the different behaviour of the nuclei of the male and female reproductive cells of animals to staining reagents, in the case of those of *Gymnogramme chrysophylla* (Filices), and finds similar results; the male sexual element is chiefly cyanophilous, the female chiefly erythrophilous. Under double staining the body of the antherozoid takes up a deep blue, while the cilia, the posterior undulating membrane, and the posterior vesicle, are coloured red. In the archegone the greater part of the nucleus of the oosphere

* Comptes Rendus, cxiv. (1892) pp. 434-7.

† Malpighia, v. (1892) p. 428.

‡ Comptes Rendus, cxiv. (1892) pp. 143-5. Cf. this Journal, 1891, p. 625.

§ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 27-9.

|| Cf. this Journal, 1891, p. 714.

stains red, though it contains a few blue elements resembling nucleoles; the protoplasm surrounding the nucleus is also an intense red.

The reactions of the antherozoid of *Aneura pinguis* (Hepaticæ) precisely resemble those of *Gymnogramme*; no observations were made on the archegones.

Sporophyte of Lycopodinæ and Ophioglossaceæ.*—Prof. F. O. Bower puts forward the theory that the so-called “fertile frond” of *Ophioglossum* is in reality an elaborated and partitioned sporange homologous with the smaller and non-partitioned sporange of the Lycopodinæ. This view is supported by a comparison of the development of the “fertile frond” in *Ophioglossum* and *Ophioderma* with that of the sporange in *Lycopodium Selago* and *clavatum*. In *Ophioderma* the archesporial tissue becomes differentiated into sporogenous masses which are soon densely filled with protoplasm and develop further into spores, and sterile tissues which intervene between these and develop into the septa between the sporanges together with part of the tapete. The whole “fertile frond” of *Ophioglossum* and *Ophioderma* will then correspond to the sub-archesporial mass of *Lycopodium*, and will illustrate the result of elaboration, partial sterilization, and consequent partitioning of the sporange.

If this view is accepted, Prof. Bower suggests that it may furnish a clue to the bridging over of the gap between the Bryophytes and Vascular Cryptogams; and that all the stocks of Vascular Cryptogams may have originated in an elaboration similar to that which can be traced in the spore-bearing members of the Lycopodinæ and Ophioglossaceæ. If such a process were carried out in a sporogone such as that of *Anthoceros*, it might result in a strobile not unlike those of *Equisetum* and *Lycopodium*.

Prothallium and Embryo of Osmunda.†—Prof. D. H. Campbell has closely investigated the structure and development of the prothallium and embryo of *Osmunda Claytoniana* and *cinnamomea*. He states that the spores of both species germinate immediately, and may form a protoneme similar to that of the Polypodiaceæ. A single two-sided apical cell is formed at an early period, which gives place to a nearly cubical one, and ultimately to a row of marginal initials. Adventitious prothallia are formed in both species, and that of *O. Claytoniana* branches abundantly. The chloroplasts are sometimes of extraordinary size in *O. cinnamomea*. The antherids differ in structure from those of other ferns, and approach most nearly those of the Hymenophyllaceæ and Gleicheniaceæ. The antherozoids resemble most closely those of *Equisetum*; they are formed by direct transformation of the nucleus; the cilia and vesicle originating from the cytoplasm. A polar body may be present in the archegone, distinct from the ventral canal-cell. The stem, leaf, and root are developed from a tetrahedral apical cell which is one of the original octants of the embryo. The development appears to approach most nearly that of the less specialized leptosporangiate forms, and the author points out several points of resemblance between *O. Claytoniana* and the Marattiaceæ.

* Proc. Roy. Soc., 1. (1892) pp. 265–73.

† Ann. of Bot., vi. (1892) pp. 49–94 (4 pls.). Cf. this Journal, 1891, p. 627.

Structure of Ophioglossum.*—M. G. Poirault calls attention to two or three points in the structure of *Ophioglossum vulgatum*. The vascular bundle of the root possesses only a single phloem-structure. The only anomaly of the root of *Ophioglossum* is the absence of a pericycle at the back of the phloem-bundles; and this occurs also in the stem. In the leaf the layer of cells surrounding the outermost sieve-tubes must be regarded as an endoderm. The formation of adventitious buds on the root does not result from the transformation of the radical cone into a leafy stem; the bud, on the contrary, has a lateral origin, and grows at the expense of a portion of the segment cut off from the mother-cell of the root. The bud is not always a ramification of the mother-root; it may have an endogenous origin in the cortex of the stem below the zone where the roots are formed.

Tubercles of Equisetum.†—According to M. Leclerc du Sablon, the underground tubercles of *Equisetum maximum* differ in several points of structure from the rhizome. The epiderm is but very slightly differentiated. In addition to the general endoderm of the vascular cylinder, each bundle in the tubercle has its own special endoderm,—a characteristic of the vascular system of the stem of some other species of *Equisetum*, e. g. *E. arvense*, *palustre*, and *sylvaticum*, but not of that of *E. maximum*. The vessels of the xylem are spiral and annular, are smaller and more numerous than in the rhizome, are irregularly disposed, and not in the form of a V, and have no lacuna on the inner side of the bundle, as is the case in the rhizome when mature. The tubercles of *Equisetum sylvaticum* agree in essential points with those of *E. maximum*.

Fossil Remains in the Culm.‡—Prof. Graf zu Solms-Laubach describes the fossil remains found in the calcareous deposits of the Culm at Glätzisch-Falkenberg in Silesia. They abound in *Stigmaria*; and the author finds also some hitherto undescribed forms. He describes one as *Zygopteris Römeri*, belonging, from the anatomy of the leaf-stalk, to a different type from the hitherto described *Z. tubicaulis*. Fragments of fern-roots and branches of *Lepidodendron* were also found, as well as fern-sporanges.

Muscineæ.

Anatomy and Physiology of Mosses.§—Herr R. Coesfeld has studied several points in the structure of Mosses, especially of *Polytrichum commune*. The elongated cells of the central bundle acquire their form by stretching, the nucleus at the same time changing from a round to a spindle-form and finally disappearing. Of the entire tissue of the stem of *Polytrichum*, this central bundle alone gives a pure cellulose reaction; neither in the central bundle nor elsewhere did reagents give any evidence of lignification. The cells of the bundle contain (in March) oil and starch-grains. The bundle is sharply marked off from the cortical tissue by a protecting sheath. The cortical tissue consists

* Journ. de Bot. (Morot) vi. (1892) pp. 69-76 (1 fig.). Cf. this Journal, 1891, p. 500.

† Rev. Gén. de Bot. (Bonnier) iv. (1892) pp. 97-101 (6 figs.).

‡ Bot. Ztg., l. (1892) pp. 49-56, 73-9, 88-98, 105-113 (1 pl.).

§ Tom. cit., pp. 153-64, 169-76, 185-93 (1 pl.).

of much shorter cells than the central bundle, resembling bast-cells in their form; they do not give a definite cellulose reaction; they contain tannin, especially in the spring. The epiderm consists of a single layer of cells, at all events in the upper part of the stem; later it divides by tangential walls. The cells of the cortical tissue are connected with one another by means of pits which often can only be detected by the use of staining reagents. They are much more obvious in *P. juniperinum*. The central bundle must be regarded as a rudimentary vascular-bundle-system; but its function is much more that of storing up and conducting food-material than of the simple conduction of water. Its collenchymatous character indicates also that it may serve as a reservoir of water.

The biserial and dorsiventral arrangement of the branches (in *Hypnum splendens*) does not depend on anatomical considerations or on inner causes of growth; both this peculiarity and the horizontal position of the branches are due to constant illumination on one side only; geotropism alone, without the co-operation of light, causes the shoot to ascend vertically.

Stem-leaves of Sphagnum.*—Dr. F. Orloff publishes, in a cardboard box, 66 photomicrographic representations of the stem-leaves of bog-mosses. Except in a few instances, the form, size, and arrangement of the cells of the leaves are clearly shown, as well as the thickness of the cell-walls, and the difference exhibited in these points by the different species and sub-species, of which 54 are delineated. The scale of magnification is uniformly 100.

Algæ.

Increase in Thickness of the Florideæ.†—Herr B. Jönsson calls attention to the concentric rings of tissue, similar to those of *Laminaria*, in the Florideæ. They are especially well developed in *Ahnfeltia plicata* and *Phyllophora membranifolia*, but occur also in other red sea-weeds. In the young apex of a shoot of *Ahnfeltia* the central string of tissue is surrounded by a chlorophyllous cortical layer, while in older parts the cortical layer is differentiated into a number of distinct rings, sometimes as many as twelve, which may be either concentric or excentric; two adjacent rings are usually separated by a single row of thick-walled cells. The inner portion of each zone is of a lighter colour than the outer portion; and the rings themselves change from within outwards, from grey-green to an intense red. This structure is undoubtedly due to a periodicity of growth; though on what causes this periodicity depends is obscure. The lighter colour of the inner portions is attributed by the author to the interruption of the light due to the activity of growth which immediately follows the re-awakening of vegetation. The structure appears to be a contrivance for increasing the flexibility of the plant. Similar phenomena occur also in *Melanthalia abscissa*, and in other seaweeds belonging to the Cryptonemiaceæ, Gigartineæ, Rhodymeniaceæ, Sphærococcaceæ, and Rhodomelaceæ.

* 'Die Stammbblätter v. *Sphagnum*,' 8 pp. and 66 pls., Coburg, 1891.

† Lunds Univ. Årskr., xxvii. (1890, 91) 41 pp. and 2 pls.

Conchocelis, a new genus of Perforating Algæ.*—Mr. E. A. L. Batters finds on empty shells, chiefly of *Mya truncata* and *Solen vagina*, a pink perforating alga representing a new type. When freed from the calcareous substance on which it grows, it is found to consist of articulated branched filaments, radiating, when young, more or less from a central point, and of very various widths, varying between 1·5 and 7·5 μ . Below the horizontal layer the filaments swell out here and there into irregularly shaped septate simple or slightly branched inflations from 20 to 30 μ in diameter, and 70 to 110 μ in length, and usually consisting of from 2 to 10 cells; in the centre of each cell is a star-shaped chromatophore. The plant appears to be propagated by means of spores formed one in each cell of the inflations. On these characters the author founds the genus *Conchocelis* belonging to the Porphyraceæ, with the following diagnosis:—Thallus minutus, e filis ramosis articulatis hic illic in utriculos septatos, forma irregulari dilatantibus, compositus; propagatio fit per sporas in cellulis utriculorum evolutas; unica spora in singulis cellulis.

Malformations of Ascophyllum and Desmarestia.†—Miss E. S. Barton describes galls on *Ascophyllum nodosum* and *Desmarestia aculeata* resembling those already detected on *Rhodymenia palmata*. Those produced on the *Ascophyllum* are almost invariably confined to the part of the thallus immediately above or below the air-vesicles, and are produced by a new species of nematode, *Tylenchus fucicolus*. The malformations on the *Desmarestia* are due to the attacks of an undescribed copepod.

Parasitic Phæosporeæ.‡—M. C. Sauvageau describes the following species of Phæosporeæ parasitic on other algæ:—*Elachistea stellulata*; *E. Areschougii*; *E. (?) clandestina*; *Ectocarpus investiens*; *E. (?) velutinus*; *E. Valiantei* Born. (sp. ined.) on *Cystoseira ericoides*; *E. brevis* n. sp. on *Ascophyllum nodosum*; *E. minimus* Näg. (sp. ined.) on *Himanthalea lorea* at Dover and Berwick; *E. luteolus* n. sp. on *Fucus vesiculosus* and *serratus*; *E. parasiticus* n. sp. on *Cystoclonia purpurascens*, *Gracilaria compressa*, and *Ceramium rubrum*; *E. solitarius* n. sp. on *Dictyota dichotoma*, *Dictyopteris polypodioides*, and *Taonia atomaria*; *E. fasciculatus*; and *Streblonemopsis irritans*. The eight parasitic species of *Ectocarpus* appear to form a natural group, agreeing in their small size, penetrating the living thallus of the host, and emerging from it in a more or less dense tuft.

Spore-like Bodies in Closterium.§—Mr. A. W. Bennett describes spore-like bodies found in *Closterium lanceolatum* and *striolatum*. They are round or elliptical, from 20 to 40 μ in diameter, bright green, and inclosed in cellulose. They do not appear to resemble any parasitic organism at present described.

Propagation and Septation of Vaucheria.||—Mr. A. W. Bennett describes a mode of non-sexual propagation in a *Vaucheria*, in the escape from the filaments of naked unciliated masses of coarsely granular

* Phycol. Mem. (Murray) i. (1892) pp. 25-8 (1 pl.).

† Tom. cit., pp. 21-4 (1 pl.). Cf. this Journal, 1891, p. 502.

‡ Journ. de Bot. (Morot), vi. (1892) pp. 1-10, 36-44, 55-9, 76-80, 90-6, 97-106, 124-31 (4 pls.).

§ Ann. of Bot., vi. (1892) pp. 150-2 (1 fig.).

|| Tom. cit., pp. 152-4.

protoplasm, which move about in the water with a jerking motion, then come to rest, and invest themselves with a coat of cellulose. *V. sessilis* var. *cæspitosa* was observed to form in its ordinary filaments thick gelatinous septa which remained suspended in the water after the rest of the filament had disappeared.

Dictyosphæria.*—Mr. G. Murray discusses the structure and systematic position of this genus of siphonous algæ, and adopts the commonly accepted view of its close alliance with *Valonia* and *Anadyomene*, among the Valoniaceæ.

Fossil Caulerpa.†—Under the name *Caulerpa Carruthersii* Mr. G. Murray describes a fossil alga from the Oolite (Kimmeridge Clay of Weymouth), hitherto regarded as an Equisetaceous plant. It appears to be nearly allied to the existing *Caulerpa cactoides*.

Chlorella, Chlorococcum, and Chlorosphæra.‡—Prof. A. Hansgirg is of opinion that Beyerinck's genus of Schizophyceæ *Chlorella* must be reunited with *Chlorococcum*, the absence of zoospores not being a character of sufficient constancy to justify the separation; and, furthermore, that both these genera must be sunk in *Protococcus*, of which he makes two sections—*Chlorococcum*, of which the species are aquatic, and *Euprotococcus*, which includes the aerial forms. Beyerinck's *Chlorosphæra* is hardly distinguishable from *Pleurococcus*, and *C. angulosa* is certainly identical with *Pleurococcus angulosus*.

Fungi.

Rabenhorst's Cryptogamic Flora of Germany (Fungi).—Parts 47–50 of this work continue the account of the Phycomyces, under the editorship of Dr. A. Fischer. The description of the Chytridiaceæ is completed with the family Hyphochytriaceæ or Cladochytriaceæ, made up of the genera *Cladochytrium* (18 species), *Amæbochytrium*, *Catenaria*, and *Hyphochytrium*. A list is appended of the species of animals and plants on which the various Archimycetes are parasitic.

The whole of the Zygomycetes are included in these parts. The account commences with a very full description of the structure of the Mucorinæ, which are divided into four families, the Mucoraceæ and Mortierellaceæ, in which the nonsexual propagation is by means of motionless spores inclosed in sporanges; and the Chætocladiaceæ and Cephalidaceæ, in which it takes place by conidia borne on conidiophores. The Mucoraceæ include the genera *Mucor* (22 species, several of them new), *Circinella*, *Pirella*, *Phycomyces*, *Spinellus*, *Sporodinia*, *Rhizopus* (7 species, 1 new), *Absidia*, *Thamnidium*, *Chætostylum*, *Helicostylum*, *Dicranophora*, *Pilaira*, and *Pilobolus* (7 species). The Mortierellaceæ are made up of the genera *Mortierella* (14 species), and *Herpocladium*; the Chætocladiaceæ of the single genus *Chætocladium*; the Cephalidaceæ of *Piptocephalis* (8 species), *Syncephalis* (17 species), and *Syncephal- astrum*.

Next follow the Oomycetes, of which we have in these numbers a complete monograph of the German species of the first order, the Sapro-

* Phycol. Mem. (Murray) i. (1892) pp. 16–20 (1 pl.).

† Tom. cit., pp. 10–15 (2 pls.).

‡ SB. K. Böhm. Gesell. Wiss., 1891, pp. 298–9. Cf. this Journal, 1891, p. 232.

legninæ. After a full account of their structure and life-history, the Saprolegninæ are classified under the two families Saprolegniaceæ and Monoblepharidaceæ. The Saprolegniaceæ comprise the genera *Pythiopsis*, *Saprolegnia* (9 species classified under an *asterophora*, a *ferax*, and a *monilifera* group), *Leptolegnia*, *Achlya* (9 species), *Aphanomyces*, *Dicthyuchus*, *Aplanes*, *Apodya*, *Apodachlya*, and *Rhipidium*. The Monoblepharidaceæ are made up of *Monoblepharis*, and a new genus separated from it, *Gonapodya*.

Effects of Mechanical Movement on the Lower Fungi.*—Mr. H. L. Russell has carried out a series of experiments on the effects of concussion on the growth of some low organisms—*Monilia candida*, *Oidium albicans*, and *Saccharomyces Mycoderma*. He finds that constant agitation affects very strongly the increase in number of the cells formed, and consequently the amount of organic matter produced, the increase in growth amounting to as much as from 200 to 300 per cent. The formation of hyphal filaments is, on the other hand, retarded by constant movement, and the amount of fermentation products, as determined by the alcohol formed, undergoes a sensible diminution. The cause of the more rapid cell-multiplication appears to be chiefly the greater aeration of the culture.

Massee's Phycomycetes and Ustilagineæ.†—In this volume Mr. G. Massee gives a general account of the structure of three groups of Fungi, the Mucorini, Peronosporæ, and Ustilagineæ, followed by a diagnosis of all the British genera and species.

Retarded Germination of Æcidiospores.‡—M. G. Poirault records an instance of the germination of the æcidiospores of *Ræstelia cancellata* at periods varying from one to two weeks after they had been placed in suitable conditions, contrary to what had previously been observed to be the case with æcidiospores. The same spores had previously withstood a low temperature of -7° to -8° C.

Parasitic Fungus on the Lombardy Poplar.§—M. P. Vuillemin gives further details of the life-history of *Didymosphæria populina*, a parasitic fungus belonging to the Pyrenomycetes, which has caused great destruction to the Lombardy poplar during recent years in the north of Europe and of America. He supports the view of Moebius|| that continual non-sexual propagation of a species is not necessarily fatal to its vigour; and attributes the liability to disease of this variety of the poplar, which has never been propagated in any other than a non-sexual manner, to a succession of severe winters, followed by wet summers, which have been specially favourable to the development of the parasite.

Gnomonia erythrostoma.¶—Herr B. Frank has studied the life-history of this parasitic fungus, which attacks both the sweet and the

* Bot. Gazette, xvii. (1892) pp. 8-15.

† 'Brit. Fungi: Phycomycetes and Ustilagineæ' (8 pls.), London, 1891. See Grevillea, xx. (1891) p. 45.

‡ Journ. de Bot. (Morot) vi. (1892) pp. 59-60.

§ Rev. Mycol. xiv. (1892) pp. 22-7 (1 pl.). Cf. this Journal, 1889, p. 681.

|| Cf. this Journal, 1891, p. 494.

¶ Zeitschr. f. Pflanzenkrankheiten, i. (1891) pp. 17-24. See Bot. Centralbl., xlix. (1892) p. 339.

bitter cherry in Germany, and describes some fresh points of interest. He finds that it is when the spermogones and peritheces of the fungus appear on the base of the lamina of the leaf near the leaf-stalk, that the disease is most infectious. It then causes "mummification" of the leaf-stalk, and the leaves remain attached to the tree. When the disease attacks only the apical portion of the leaves, they fall off, and do not spread the infection.

Myxotrichum.*—M. J. Costantin reduces this genus of Fungi to the two species *M. chartarum* and *æuginosum*. In the former species the spores are distinctly formed in an ascus the membrane of which very soon disappears into gelatin. It is very nearly allied to *Gymnoascus uncinatus*, but differs in its habit, growing on paper instead of being fimicolous, and in some points of structure. The other alleged species of *Myxotrichum*, *M. rarum*, *murorum*, *fuscum*, and *resinæ*, have nothing in common with these two, and are probably conidial forms of Ascomycetes.

New polymorphic Hypocreaceæ.†—Sig. A. N. Berlese describes two new species of Hypocreaceæ, with the following characters:—

Melanospora globosa. This occurs in four distinct forms—microconidial, megaconidial or chlamydosporous, spiro-bulbilliferous, and perithecial or ascophorous. The conidial form is destined for the diffusion of the species. The spore-bulbils cannot be regarded as the result of the degradation of ascophorous peritheces, but are an apogamous apparatus for the preservation of the species. There does not exist in this species a true pollinode; nor can any distinct sexual function be attributed to the primary cortical hyphæ. We have an example of the *apandry* which occurs in other Ascomycetes. The microconidial form is identical with an *Acrostalagmus* allied to *A. atrum*, while the chlamydosporous form is known as *Acremonium atrum*.

Sphaeroderma bulbilliferum. This occurs also in the same four forms. The microconidial form represents a species of the alleged genus *Oospora*, the chlamydosporous form one of *Mycogone*, the sporo-bulbilliferous form one of *Papulospora*.

Ripe-rot of Grapes and Apples.‡—According to Mr. E. A. Southworth, the so-called bitter-rot of the apple is produced by the same parasitic fungus as the ripe-rot of the grape, *Glæosporium fructigenum* (*Ascochyta* or *Septoria rufo-maculans*); but in the latter case it does not produce the bitter taste which it does in the former. It can apparently pass, by infection, from one fruit to the other. Its attacks cause the grapes to become transparent, and to wither up; on the apple it produces brown depressed spots, which spread rapidly over the whole surface. The microscopical structure of the fungus is extraordinarily variable. The spores are either two- or three-celled, and often produce secondary spores. The pycnids and conceptacles were not satisfactorily observed.

Perithece of *Aspergillus fumigatus*.§—Dr. J. Behrens finds the hitherto unknown peritheces on cultures of this fungus obtained from

* Bull. Soc. Bot. France, xxxviii. (1891) pp. 314-8.

† Malpighia, v. (1892) pp. 386-418 (2 pls.).

‡ Journ. of Mycol., vi. (1891) pp. 164-73 (1 pl.). See Bot. Centralbl., I. (1892) p. 56.

§ Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 335-7.

fermenting tobacco. Their mode of formation shows that *Aspergillus fumigatus* is the conidial form of a true *Eurotium*.

Lachnidium acridiorum.*—M. A. Giard has further investigated the life-history of this fungus parasitic on *Acridium peregrinum*. It occurs in two principal forms, a *Cladosporium* and a *Fusisporium* form. In old cultures there are frequently found chlamydospores, formed at first of a single cell, afterwards of two, placed one above the other, the terminal one being larger and with thicker walls. The fungus has then all the characters of the genus *Sarcinella*. A parallelism is thus established between the different stages of *Lachnidium* and those of *Cladosporium*; and it is probable that *Lachnidium* must be placed either in the Perisporiaceæ or the Sphæriaceæ; and that the genera described as *Hormodendron*, *Sarcinella*, *Stemphylium*, *Macrosporium*, and *Mystrosporium*, are but stages in the evolution of various Ascomycetes.

Spotted Anthracnose.†—M. L. Mangin describes the nature of the injuries inflicted on the vine by this disease, caused by the attacks of *Sphaceloma ampelinum*. The deformations are essentially due to the progressive and complete dissolution of the pectic substances caused by the parasite. It also causes an irritation which results in the suberification of the layer of cells adjacent to the part attacked, which cuts off the diseased from the healthy part. It is in the buds and the young branches that the parasite attains its fullest development.

Doassansia.‡—Dr. W. A. Setchell gives a further minute description of the twelve species of *Doassansia* which he has already described, together with the allied genera *Cornuella* and *Burrillia*.

Oak-cancer.§—According to Prof. R. Hartig, this disease, which is exceedingly destructive to young oaks in Germany, is due to the attacks of a parasitic pyrenomycetous fungus *Aglaospora teleola*, the mycelium of which penetrates into the wood. Further damage is then often caused by *Nectria ditissima*.

Dictyonema.||—M. P. Hariot regards this as a genus of true lichens, including as synonyms *Dichonema*, *Rhipidonema*, and *Laudatea*. The fungus belongs to the Hypochnaceæ, and probably to the genus *Coniophora*; the basidia are four-spored; the alga is a *Scytonema*. All the species hitherto described should be included under one, *D. sericeum*, which occurs in various forms. The thallus is sometimes cæspitose and but little developed; sometimes silky, spongy, filamentous at the margin and reticulate; when fully developed it is neither reticulate, silky, nor spongy. The alga undergoes considerable change in the lichenification.

"Ginger-beer Plant."¶—Prof. H. Marshall Ward has examined the nature of the compound organism which results from the fermenta-

* Comptes Rendus, exiii. (1891) pp. 813-6. Cf. this Journal, 1891, p. 636.

† Loc. cit., cxiv. (1892) pp. 777-80.

‡ Ann. of Bot., vi. (1892) pp. 1-48 (2 pls.). Cf. this Journal, 1891, p. 780.

§ SB. Bot. Ver. München, March 14, 1892. See Bot. Centralbl., l. (1892) p. 74.

|| Bull. Soc. Mycol. France, vii. (1891) pp. 32-41. See Bot. Centralbl., 1892, Beih., p. 19.

¶ Proc. Roy. Soc., l. (1892) pp. 261-5.

tion of ginger-beer. It occurs as jelly-like semi-transparent yellowish-white masses, aggregated into brain-like lumps, or forming deposits at the bottom, and presenting a general resemblance to kephir. Prof. Ward finds that it consists essentially of a symbiotic association of a specific saccharomycete and a specific schizomycete, both new, which he proposes to name *Saccharomyces pyriformis* and *Bacterium vermiforme*. In all the specimens examined, *Mycoderma cerevisiæ* and *Bacterium aceti* were also met with, and, as foreign intruders, some or other of the following:—(1) a pink or rosy yeast-like form, *Cryptococcus glutinis*; (2) a small white microbial top-yeast, with peculiar characters, and not identified with any known form; (3) the ordinary beer-yeast, *Saccharomyces cerevisiæ*; (4) three, or probably four, unknown yeasts of rare occurrence; (5) a spore-forming bacillus which liquefies gelatin with a greenish tinge; (6) a large spore-forming bacillus which also liquefies gelatin; (7 and 8) two, perhaps three, other Schizomycetes not identified; (9) a large yeast-like form which grows into a mycele, *Oidium lactis*; (10) a common blue mould, *Penicillium glaucum*; (11) a brown torula-like form, *Dematium pullulans*; (12) one, or perhaps several, species of torula, of unknown origin and fate.

Saccharomyces pyriformis is an anaerobic bottom-yeast, forming spores, and developing large quantities of carbon dioxide, but forming little alcohol. It has also an aerobic form, in which the cells are club-shaped or pyriform. It inverts cane-sugar and ferments the products, but does not ferment milk-sugar. *Bacterium vermiforme* occurs as filaments or rodlets, curved or straight, encased in a remarkably thick firm gelatinous sheath, and decidedly anaerobic.

Cultivating the Ascospores of Yeast.*—Prof. J. C. Arthur states that vigorous actively growing yeast-plants which are transferred directly to moist slabs of plaster of Paris, develop their ascospores with great rapidity; the sudden change from a condition with abundance of nutriment to one with almost total absence of it, appears to favour their development. The method pursued by Prof. Arthur was to add a little yeast taken from a fresh cake of Fleischmann's compressed yeast to a Pasteur solution. In a day or two the liquid was poured out of the flask. Some of the flocculent material adhering to the glass was spread upon the surface of a freshly made cake of plaster of Paris, and the whole covered. In a few days an abundant crop of ascospores was obtained, which were easily coloured by methyl-violet.

African Uredineæ.†—Herr P. Magnus describes a collection of Uredineæ from the Italian colony of Erythræa on the Red Sea, among which is an interesting new species *Pucciniastrum Schweinfurthii*, parasitic on a species of *Rhamnus*. Its mycele permeates whole twigs and branches of the host, fructifying on the under side of the leaves, and producing a true "witch-broom." The æcidium of another species, *Phoma Acaciæ*, produces a similar malformation on *Acacia etbaica*.

* Bot. Gazette, xvii. (1892) pp. 92-3.

† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 43-9 (1 pl.).

Uromycetes of the Leguminosæ.*—M. P. Hariot describes thirty-five species of *Uromyces* parasitic on various species of Leguminosæ, five belonging to the section Eu-uromyces, twelve to Hetero-uromyces, six to Uromycopsis, and twelve to Lepto-uromyces.

Puccinia.†—Sig. R. Pirota proposes a classification of the species of this genus under five sections, viz. :—(1) Leptopuccinia, (2) Micro-puccinia, (3) Hemipuccinia, (4) Pucciniopsis, and (5) Eupuccinia. The first three sections are again divided into species with and species without paraphyses. In Pucciniopsis no species is known with paraphyses. Eupuccinia is again divided into Auto-eupuccinia and Hetero-eupuccinia; in the first there are no species with paraphyses; the second is again divided into those with and those without paraphyses.

Vascular Hyphæ of the Agaricineæ.‡—From an examination of a large number of species belonging to 44 genera distributed through the various forms of Agaricineæ, M. C. Van Bambeke has arrived at the following general conclusions:—

Some elements, distinct from the fundamental and connecting tissues, called laticiferous vessels, sap-ducts, oleiferous vessels, &c., and included under the general term *vascular hyphæ*, are to be met with probably in all the Agaricineæ. The number of the vascular hyphæ, their dimensions, shape, their arrangement, and course, and the nature of their contents, vary according to the genus, and often in the same genus according to the species, and in each species in the different parts of the carpophore. The vascular hyphæ may be found in all parts of the carpophore, that is, in the stipe, the pileus, and the lamellæ. The last subdivisions of the vascular hyphæ terminate frequently in the lamellæ between the elements of the hymene, either in an open end or in cystids; similar terminations are found sometimes at the periphery of the pileus and of the stipe. The contents of the vascular hyphæ are often of a complicated chemical composition, and include, among other substances, independently of colouring matters, resinous substances, fatty matters, albumen, glycogen, and dextrines. The vascular hyphæ other than the laticiferous vessels of the Lactario-Russulacææ, do not deserve, in a general sense, the name of oleiferous vessels. From the presence of glycogen in the vascular hyphæ, especially in their young stage, and from their penetration into the different parts of the carpophore, we may conclude that these organs play an important part in the distribution of nutritive substances; but it is probable that the vascular hyphæ fill yet other functions; considering their frequent termination at the periphery (between the elements of the hymene, &c.), it may be that they are instrumental in the elaboration and excretion of certain fluids or solids. At present the vascular hyphæ have only been employed, as elements of classification, for the group of the Lactario-Russulacææ. They may, however, be used with the other Agaricineæ, for they may furnish in many cases important characteristics, either generic or specific, in the same way as the fundamental, connecting, and supporting tissues.

* Rev. Mycol., xiv. (1892) pp. 11-22.

† Nuov. Giorn. Bot. Ital., xxiii. (1891) pp. 578-81.

‡ Bot. Jaarb. (Gent) iv. (1892) pp. 176-239.

Hirsutella, a new genus of Entomogenous Hymenomycetes.*—M. N. Patouillard describes under this name a new genus of Clavariæ, with the following diagnosis:—Homobasidial Hymenomycetes, in the form of simple or branched, erect, rigid, almost coriaceous clubs; hymenium amphigenous, distinct; basids nearly or quite sessile; subhymenium 0; sterigmas 1 or 2, subulate, greatly elongated; spores colourless. The species on which the genus is founded, *H. entomophila*, was found in Ecuador parasitic on a coleopterous insect allied to the Chrysomeleæ, the dead body of which was fixed by the mycelle of the parasite to the lower surface of a leaf. The basids differ in form from that of most Clavariæ, being regularly ovoid and narrowed at both ends. The single sterigma is inserted at the summit of the basid, and bears a single spore at its apex. M. Patouillard proposes to refer to the same genus *Pterula serosa* Peck, and *Typhula gracilis* Berk. and Desm.

Septobasidium, a new genus of Hymenomycetes.†—M. N. Patouillard describes under this name a new genus of heterobasidious Hymenomycetes, founded on *Thelephora pedicellata*, to which is added also a new sp., *S. velutinum*. The genus is characterized by being filamentous and coriaceous, not gelatinous, with a distinct hymene, the basids of which are at first simple and globular, afterwards cylindrical and septated transversely, straight or curved, bearing the sterigmas on their convex portion.

New Genera of Gastromycetes.‡—Mr. A. P. Morgan describes the two following new genera of puff-balls from the United States.

Bovistella. Myceles funicular, rooting from the base; peridium sub-globose, with a well-developed base; cortex a dense floccose sub-persistent coat; inner peridium thin, membranaceous, dehiscent by a regular apical ostiole; sub-gleba cellular, cup-shaped above and definitely limited, persistent; capillitium originating within the tissue of the gleba, the threads free, short, several times dichotomously branched, the main stem thicker than the diameter of the spores, branches tapering; spores small, globose or oval, even, pedicellate.

Catastoma. Mycele filamentous, proceeding from all parts of the surface; peridium sub-globose, without a thickened base; cortex a fragile coat of loosely interwoven hyphæ; capillitium originating from the inner surface of the peridium; spores globose, warty, pale brown, sessile or pedicellate.

Protophyta.

a. Schizophyceæ.

Schmidt's Atlas der Diatomaceen-Kunde.—The last part of this magnificent work (Heft 43, 44) comprises 8 plates (169–176) in which are illustrated species belonging to the genera *Aulacodiscus*, *Biddulphia*, *Grayia*, *Actinoptychus*, *Truania*, *Actinodiscus*, *Triceratium*, *Lithodesmium*, *Trinacria*, *Navicula*, *Melosira*, *Paralia*, and *Trochosira*.

* Rev. Mycol., xiv. (1892) pp. 67–70.

† Journ. de Bot. (Morot) vi. (1892) pp. 61–4 (2 figs.).

‡ Journ. Cincinnati Soc. Nat. Hist., xiv. (1892) pp. 141–8 (1 fig.).

B. Schizomycetes.

Nature and Action of Enzymes produced by Bacteria.*—Dr. A. Macfadyen finds that the bacteria which liquefy gelatin do so by means of a ferment or enzyme, the action of which on gelatin can be demonstrated apart from the cells that produce it. The amount of this proteolytic enzyme secreted varies with the nature of the soil; the amount present in gelatin cultures of the bacteria is relatively small, that secreted in simple meat-broth cultures is much larger, and this fluid is the best medium for the production of the soluble ferment. The action, as well as the amount, of the ferments varies with the nature of the soil. The active ferments are contained in glycerin extracts of the bacteria; and the glycerin extracts of spirilla reduce Loew's reagent, acting in this way like the protoplasm of the living cell.

Streptothrix and Cladothrix.†—According to MM. C. Sauvageau and M. Radais, these two genera have been confounded with one another by some writers. *Cladothrix* is, however, a true Schizomycete, while *Streptothrix* includes *Actinomyces*, and is a hyphomycetous fungus. Both these names must, however, be suppressed in favour of *Oospora*. The authors describe two new species, *O. Metchnikowi* met with in the water of a conduit, and *O. Guignardi*, accidentally in a culture. The formation of spores was observed in the latter, but not in the former species.

Research-methods and the Immunity Question.‡—The remarks of H. Buchner, on the methods adopted by the phagocytists and plasmatists in dealing with the immunity question, really constitute a reply to the doings of MM. Metschnikoff and Roux, noticed in this Journal, 1891, pp. 240 and 785. These remarks are chiefly polemical and critical, do not adduce any new facts or ideas, and are merely iterations of the views of the plasmatists, that is to say, that the chief bactericidal virtues reside in the blood-plasma, and that the experimental methods adopted are free from objection. The author, however, admits that some of the phenomena observed by the phagocytists really occur, but that the interpretation put on them is open to objection.

It is conceded that phagocytosis exists, that bacteria are picked up by certain cells, but whether the cell devours the microbe and continues to live, or whether the pair pass away together, is not yet proven. According to the author any influence unfavourable to the virus is exerted before the inception by the amœboid cells, the phenomena of leucocytosis and of phagocytosis being a sequel or after consequence of this unfavourable influence.

Immunity and Resistance to Toxins.§—Messrs. L. Brieger, S. Kitasato, and A. Wassermann, after laying down the proposition that an organism is immune when a disease-germ is unable to develop within it, point out that the detrimental action of micro-organisms is due either to a mechanical interference with those conditions without which life

* Journ. Anat. and Physiol., xxvi. (1892) pp. 409-29.

† Comptes Rendus, cxiv. (1892) pp. 559-62.

‡ Centralbl. f. Bakteriöl. u. Parasitenk., x. (1891) pp. 727-36.

§ Zeitschr. f. Hygiene, xii. pp. 137-82. See Biol. Centralbl., xii. (1892) pp. 250-6.

becomes impossible, or to the fatal toxæmia resulting from the absorption of the metabolic products of the micro-organism.

As an example of the first kind anthrax is cited, and of the latter cholera, typhus, diphtheria, tetanus. Thus the former class of pathogenic organism may be termed septic and the latter toxic, and while the septic organisms are combated either by immersing the organism or rapidly killing the bacteria, a toxæmia can only be opposed by the encountering it with an antidote.

The toxæmia may be neutralized in one of two ways, either by a direct antidote or by means of a preliminary treatment which shall render the animal unsusceptible (*giftfest*).

The attention of the authors was chiefly devoted to obtaining a substance which should possess the property of neutralizing, or at least being inimical to bacterial poison. This was found in extracts of the thymus and lymphatic glands, and numerous examples are given of the efficacy of these substances against the poisons of cholera, tetanus, diphtheria, &c. Even the blood-serum of rabbits which had been rendered invulnerable by means of the thymus extract was found to confer similar immunity.

But the interesting curiosity about the immunizing substance is that after 11 it is not contained in the thymus but is only developed therein after bacteria have been cultivated in a nutrient medium to which the thymus extract has been added. For no amount of the thymus extract of itself confers even modified immunity, consequently the immunizing substance must be a bacterial product; and this is confirmed by the fact that there can be obtained from typhus cultivations a substance which will confer on mice invulnerability against very strong typhus intoxication. The cells of toxic bacteria therefore produce at one and the same time a specific poison and a substance inimical to this poison. In the typhus bacilli it remains incorporated with the microbe itself, for only small quantities of the protective principles can be obtained after passing a cultivation through a Chamberland's filter.

Narcosis and Immunity.*—Prof. E. Klein and Dr. C. F. Coxwell give the results of some experiments made by narcotizing frogs and rats with a mixture of equal parts of chloroform and ether, and inoculating them with anthrax. The narcosis was kept up for some minutes, and the injection was a pretty strong dose of virulent anthrax, the frogs receiving the virus in the dorsal lymph-sac, and the rats in the subcutaneous tissue of the groin. The object of these experiments was to see to what extent the natural immunity of these animals would be affected by these anæsthetics.

In series i. frogs, in series ii. rats, were narcotized, and injected during narcosis. All died; all the control animals remained alive. In series iii. the injections were made at various intervals before narcotization: one of these showed that anthrax spores were not destroyed in four hours. In series iv. the injections were made after narcosis; it was found that one hour sufficed for the animals to recover from the effects of the narcosis.

* *Centralbl. f. Bakteriol. u. Parasitenk.*, xi. (1892) pp. 464-7.

Experiments on similar lines made with a number of other pathogenic micro-organisms on refractory animals gave negative results.

Denitrifying Aerobic Ferment found in Straw.* — After alluding to the existence of the nitrifying ferment present in all cultivated soils, M. E. Bréal shows that there exists another ferment in straw and other vegetable débris which has a denitrifying action. If straw be tested with diphenylamin sulphate, the presence of nitrates on its surface can always be demonstrated; but if it be kept for a few days in water the reagent no longer indicates nitric acid, although it is sensitive to one ten-millionth of a gramme. If to the straw water be added continually increasing quantities of nitrates, these will rapidly disappear.

That this reduction of nitric acid is due to a ferment may be shown by sterilizing the straw by means of heat or an antiseptic such as the bichloride of mercury; the nitrates then no longer disappear.

Bacterioidal Forms in Tissues and Eggs of Insects.† — Prof. F. Blochmann describes bodies which resemble in many respects bacteria. In the fat-body of insects, such as *Phyllodromia germanica* and *Periplaneta orientalis*, these rodlets may be easily seen if a small piece of this tissue be squeezed between cover-glass and slide, and examined in water or some indifferent menstruum. They may easily be demonstrated as cover-glass preparations and by staining with gentian violet. The rodlets are 6–8 μ long, and usually slightly curved. The ends stain deeply, while the middle part remains as a clear space. Sections exhibit the structure and relations of these bodies even better than cover-glass preparations. The material should be fixed with alcohol, and stained with logwood, or by Gram's method.

The rodlets are seen singly or in pairs, the pairs being shorter than the single rods. In some cases there is an expansion at the ends which seems constricted off from the rod. Similar appearances were observed in some eggs of these insects.

Besides the two insects mentioned, the rodlets were found in many ants wherein they are longer, measuring 10–12 μ , and exhibiting in the middle a strongly refracting corpuscle, which became more visible after treatment with 1 per cent. acetic acid.

With regard to these bodies, the important question arises whether we have to deal with bacteria living in symbiosis with the insects, or whether the bodies are products of the cells in which they are found.

In support of the former view is the fact that Prazmowski has cultivated the bacterioidal forms of the Leguminosæ, while against it are the negative results of the author's own cultivation experiments.

Pigment of *Bacillus pyocyaneus*.‡ — Dr. Rohrer cultivated, from the pus of a case of acute otitis media, *Bacillus pyocyaneus* on gelatin rolls to which 1/4–1 cm. of 2 per cent. hexaethyl-violet solution had been added. The principal result appears to have been that though the formation of pigment was not prejudiced, yet the blue and fluorescing pigment was replaced by dark brown-red pigment, pyoxanthin. On potato,

* Comptes Rendus, cxiv. (1892) pp. 681–4.

† Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 234–40.

‡ Tom. cit., pp. 327–35.

the pigment, at first red-brown, soon assumed a dark-green hue, while old cultivations of *B. pyocyaneus* α and β developed yellowish-red or greyish-red pigment.

Albuminoid cultivations yielded fluorescing pigment through twelve generations, while on yelk pyoxanthin was soon and copiously developed. Heating bouillon cultivations up to 37° C. did not seem to have much influence on pigment production. On 2 per cent. pepton water and on sterilized human saliva, blue pyocyanin was exclusively produced.

The virulence of the particular *B. pyocyaneus* with which the author experimented, and which was originally obtained from the middle ear, was shown by the death of the animal experimented on. From the tissues and juices were obtained cultivations which yielded copious pigment formation.

The author's own experiments are preceded by a lengthy summary of the results obtained by previous observers.

Influence of the Soluble Products of *Staphylococcus pyogenes aureus*.*—MM. A. Rodet and J. Courmont find that if the soluble products secreted by *Staphylococcus pyogenes aureus* be injected into rabbits, the sensitiveness of these animals towards the pyogenic microbe is increased.

The simultaneous introduction of this micrococcus and of its soluble products hastens the animal's death, and favours suppuration if the former is present in the blood and the latter be injected into the tissues.

The organism retains this susceptibility as strongly after a lapse of three months as after two days. Kidney lesions were frequently present under these conditions. Filtered cultivations retained this favouring property for 20–24 days after filtration, although their toxicity diminished. No perceptible influence was observed from cultures of different ages. More than 60 animals were experimented on.

Decolorizing Bacillus obtained from Sputum.†—M. Legrain isolated from phthisical sputum a bacillus which possesses in a striking degree the faculty of decolorizing solid nutrient media which have been stained with anilin dyes. From the experiments carried out, it would seem that this bacillus is identical with a species described by Cazal and Vaillard in the 'Annales Pasteur,' 1891. This decolorizing potentiality is intimately connected with the fact that the bacillus imparts a strong alkaline reaction to the medium in which it thrives.

Natural Methods of Elimination of *Staphylococcus pyogenes aureus*.‡—A male aged twenty, who for six weeks had been suffering from boils on the left forearm, hurt his left knee, but the skin was not wounded. The next day there was pain and swelling of knee, and these were succeeded by symptoms of suppuration fever, high temperature, profuse sweatings, delirium. The knee-joint was opened, and from the exudate

* La Province Méd., 1891, p. 138. See Centralbl. f. Bakteriologie u. Parasitenk., xi. (1892) p. 249.

† Annales de l'Institut Pasteur, 1891, p. 705. See Centralbl. f. Bakteriologie u. Parasitenk., xi. (1892) p. 56.

‡ La Riforma Med., 1891, p. 289. See Centralbl. f. Bakteriologie u. Parasitenk., xi. (1892) p. 250.

was cultivated *St. pyogenes aureus*. During the after course of the disease the skin became covered with a miliary vesicular eruption, from the contents of which, and also from the urine, were cultivated *S. pyogenes aureus*, but no other organism.

This case of *Staphylococcus* septicaemia with traumatic suppurative arthrosynovitis shows, says Sig. G. Tizzoni, that though the conditions for destroying the pathogenic agent are wanting in the blood, the organism strives to free itself therefrom in various natural ways, as by the skin and kidneys. Hence, not only the wound-discharges, but also the urine and linen of patients so suffering should be carefully disinfected.

Appearance and Spread of Micro-organisms in Alimentary Canal of Animals.*—Until recently the time of the first appearance of micro-organisms in the intestinal canal could not be considered as settled. Bienstock maintained that no bacteria could be found in the meconial faeces of children fed entirely on milk. On the other hand Escherich discovered microbes in the rectal contents in from 4 to 18 hours after birth. Yet neither the one nor the other of these investigators touched the question when the presence of bacteria in the small and large intestine can be determined, and also left undecided whether bacteria could gain entrance to the intestinal tract per anum.

To solve these problems D. Popoff made bacteriological examinations of the foetal meconium of calves and of the intestinal contents of newly born cats and dogs. In the latter instance animals which had been suckled and also those which had not were submitted to examination.

The author's results were as follows. The foetal meconium contains under physiological conditions neither aerobic nor anaerobic bacteria, but it serves as a good nutrient medium for bacteria. The time of the appearance and spread of microbes in the intestinal canal of newly-born animals depends entirely on the milk. The oesophagus is the only way by which bacteria and their spores penetrate into the intestinal canal. Bacteria can be demonstrated in the meconium twenty-four hours after birth.

Influence of Variations of the Medium on the Action of Pyogenic Microbes.†—M. Herman made experiments with *Staphylococcus pyogenes aureus*, the cultivations being regularly transferred every two days to fresh calves' bouillon to which 2 per cent. pepton and 1 per cent. sodium chloride were added; the temperature was constantly 37°. Repeated countings of the plates showed that in forty-eight hours 1 ccm. of these cultivations contained an average of 520 millions of germs.

The results attained are summed up by the author as follows:—

- (1) At least half a milliard of staphylococci are necessary (a two days' cultivation at 37°) to produce a subcutaneous abscess in a rabbit.
- (2) Certain chemical substances, themselves not being pyogenic, favour the action of *St. albus*; for example, 3 per cent. carbolic acid, watery extract of staphylococcus cultivation, and 1 per 1000 sublimate.
- (3)

* Wratsch, 1891, No. 39. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xi. (1892) pp. 214-5.

† *Ann. Inst. Pasteur*, 1891, p. 243. See *Centralbl. f. Bakteriol. u. Parasitenk.*, x. (1891) p. 803.

The effect of an inoculation varies considerably with the infection path, each tissue having very different power of resistance, the order of sensitiveness being anterior chamber of eye, vascular system, connective pleura, meninges, peritoneum. (4) Division of the sciatic nerve favours the localization of staphylococci circulating in the blood.

Hereditary Transmission of Characters artificially acquired by *Bacillus Anthracis*.*—M. C. Phisalix finds that by heating successive generations of anthrax cultivations up to 42°, these bacilli lose their power of forming spores, and that when the fourteenth generation is reached the cultivations are not only asporogenous, but injections into mice are inert. As a result of these experiments, the author infers that slight modifications impressed on these microbes may become permanent in the course of a certain number of generations, and that under these conditions is produced a real accumulation of hereditary influences.

Effect of Carbonic Acid on the Vitality of Micro-organisms.†—The results obtained by Herr C. Fraenkel from experiments with a view to ascertaining the action of carbonic acid on micro-organisms may be summed up very shortly. A certain number of bacteria will thrive in CO₂ almost just as well as in ordinary atmospheric air. Others may grow in CO₂, but their development is more or less retarded or impeded. A third group will not grow when cultivated under the usual conditions, but will develop at incubation temperature. A large number, for example many saprophytes, will not thrive in CO₂ under any conditions; these may not be killed by the gas, for on replacing it with atmospheric air they will begin to grow again. Some bacteria, and among these are important pathogenic species, are killed by CO₂; yet, notwithstanding its inhibitive and partially antiseptic action, CO₂ has no power to arrest decomposition; nor does it appear to possess any power to attenuate the virus of pathogenic bacteria.

A relatively slight addition of ordinary atmospheric air to the CO₂ will allow even the species most sensitive to the presence of carbonic acid to develop.

In all forty species of micro-organisms were experimented with, and these included the best known of the pathogenic saprophytic phosphorescent, &c., bacteria, e. g. *Bac. typhi abd*, *Pneumococcus*, bacillus of lactic fermentation, yeasts, *M. prodigiosus*, *Bac. Indicus* and *phosphorescens*, *Proteus vulgaris*, *St. pyogenes*, *St. pyogenes aureus*, &c.

Effect of Drying on some Pathogenic Micro-organisms.‡—Sigg. S. Sirena and G. Alessi used the following pathogenic bacteria in some experiments made for the purpose of ascertaining the effect of drying on their vitality, viz.:—cholera, anthrax, swine erysipelas, enteric, fowl cholera, glanders, and Fraenkel's diplococcus. The drying process was effected by means of sulphuric acid, chloride of calcium, incubation at 37°, dry room in the shade, moist room, in vitro exposed to sunlight, sunlight and free air.

The authors sum up their results as follows:—(1) Drying is a

* Comptes Rendus, cxiv. (1892) pp. 684-6.

† Zeitschr. f. Hygiene, v. (1889) pp. 332-62.

‡ La Riforma Med., 1892, Nos. 14 and 15. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 484-5.

powerful disinfectant. (2) The bactericidal effect of drying is to be ascribed to the withdrawal of water from the media holding the bacteria. (3) The quicker and more perfect the removal of water, the quicker and more perfect the disinfection. (4) The different results of drying are dependent partly on the species of bacteria, and partly on the kind of drying. (5) Sunlight kills even the most resistant micro-organisms,

Germicidal, Globulicidal, and Antitoxic Action of Blood-serum.*—The power of cell-free serum of annihilating bacteria (germicidal), destroying red corpuscles of other animals, and of killing leucocytes (globulicidal) is well known, but any satisfactory explanation of this property has not yet been put forward. In discussing this question, Herr H. Buchner shows how the globulin of serum and the albumin can be separated by means of CO_2 , water, and very dilute H_2SO_4 , both bodies retaining the property alluded to. They may, however, be removed from blood-serum by heating it up to 55° and by diluting with distilled water, but are retained in presence of physiological salt solution, and even restored by adding 0.7 per cent. of NaCl to serum which has been diluted with water.

The loss of vital property in animal cells resulting from the addition of distilled water, is usually ascribed to osmotic processes, but for a cell-free fluid this explanation is not feasible. On the contrary it must be admitted that the dilution does not alter the chemical composition, but effects some change in the peculiar arrangement of the molecules in proteid bodies. Analogous examples are frequent enough in the chemistry of the organic carbon compounds and enzymes. Thus trypsin, after having been heated for an hour up to 60° , loses its power of dissolving albumen, while its chemical composition is unaltered. But the question at issue is not one of mere chemical but of physiological action, and therefore all the more difficult, since it deals not with simple substances, but complex structures, and with their action on bodies of equally complex composition. The examination is conducted in fact, not with chemical reagents but with living cells, leucocytes, red corpuscles, and bacteria. In general terms the effect of serum albumen is injurious to alien cells, and varies not only in degree, but in the time it takes to come into operation.

The author then proceeds to the antitoxic action of serum, the proteids of which not only destroy cells, but also their metabolic products, the toxins and toxalbumens.

Effect of Sublimate on Anthrax Spores.†—Herr Geppert found that if anthrax spores were soaked in 1 per thousand sublimate solution for 20 hours, the results from inoculation varied according as the sublimate had at the end of disinfection been precipitated or not by weak solution of ammonium sulphate. After a comparatively short disinfection period, all the spores seemed to have lost their power of germinating; but from this apparently dead condition they were awakened by precipitation. Yet the results were curious; for in the first

* München. Med. Wochenschr., 1892, No. 8. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 486–8.

† Deutsche Med. Wochenschr., xvii. No. 37. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) p. 485.

stage the spores would not develop in cultivations, but they would in the animal body; in the second they would in both; in the third they could be cultivated, but had no effect on the animal organism. Later on (fourth stage) there was no development.

Influenza Bacillus obtained from Saliva of Domestic Animals.*—

Dr. Fiocca describes a bacillus which he has isolated from the saliva of cats and dogs, and which he regards as being closely allied to the micro-organism described by Pfeiffer.

Subcutaneous injections made on rabbits kill these animals in 24 hours, the most prominent morbid phenomenon being acute inflammation of the chief serous membranes. The microbe was found in all the tissues and juices of the body. The bacillus resembles that of rabbit septicæmia in shape but is smaller, its breadth being $0.33-0.20 \mu$, and as its length is only a little greater, and as it usually is observed in pairs, it may easily be mistaken for a diplococcus. When grown on potato the coccoid form is predominant, but in bouillon and in blood of white mice the bacillary shape becomes apparent. With exception of fuchsin solutions it is not easily stained with anilin dyes. The ends of the organism were more chromophilous than the centre, and this polarity of the plasma is connected with reproduction, for before fission the plasma aggregates at the ends, the bacillus elongates and then divides at the clear central interval.

It is a motionless facultative aerobe growing well on the usual media, and is pathogenic to rabbits, guinea-pigs, rats, and mice.

Microbe of Yellow Fever.†—Dr. Freire, who asserts that he has discovered the microbe of yellow fever, and that he has obtained a vaccine from attenuated cultivations, again defends his position against the attack of Sternberg and others who deny both the microbe and the vaccine.

According to the author his microbe is a Staphylo-streptococcus, stainable with all the usual anilin pigments and growing on all nutrient media. The micro-organism produces both a yellow and black pigment, the former causing the jaundice, the latter pigment the black colour of the vomit. The attenuated virus was produced by breeding down on gelatin, and the third generation afforded a useful vaccine.

According to the author the results of protective inoculations on man and animals are very favourable.

Pneumococcus observed during Influenza Epidemic at Charkow.‡—

During last autumn and winter, says S. Kostjurin, there was in Charkow an influenza epidemic with frequent cases of pneumonia, the clinical course of which was different from that of ordinary croupous pneumonia; the characteristic temperature curve and the ruddy sputum were absent. The cases were under the care of Prof. Obolensky. Microbes which were apparently identical with Fraenkel's diplococcus were always

* Centralbl. f. Bakteriologie u. Parasitenkunde, xi. (1892) pp. 406-9.

† Deutsch. Med. Wochenschr., 1891, No. 17. See Centralbl. f. Bakteriologie u. Parasitenkunde, x. (1891) pp. 805-6.

‡ Wratsch, 1892, No. 4. See Centralbl. f. Bakteriologie u. Parasitenkunde, xi. (1892) pp. 471-2.

observed. But from the clinical aspects of the disease it was considered desirable to obtain more accurate observations of the biological characters of this microbe by experiments on animals.

Pure cultivations of the bacteria were obtained by the author in the usual manner. They were found to grow on agar at ordinary temperature, more above than along the track, as a greyish-white overlay with rounded ends. Bouillon became cloudy in twenty-four hours, and in four to six days a mucinoid substance appeared. They retained their form and virulence for quite a month. Animals were not killed by subcutaneous or intra-thoracic injection. The pleura was unaffected, and no exudate was observed. The spleen was always increased to three to four times its ordinary bulk. Red hepatisation disappeared after three to four weeks. The bacteria were stained by Loeffler's and Gram's methods.

The experiments on animals gave the following results. Rabbits are immune. Guinea-pigs and white rats sickened both after subcutaneous and intra-pleural injection, but recovered after five to six weeks. The post-mortem appearances resembled those of croupous pneumonia. The author believes that the diplococcus found by him is characteristic rather of influenza than of simple pneumonia.

Yeasts and Bacteria of Natural and Artificial Wines.* — MM. Schaffer and von Freudenreich have reported on the micro-organisms existing in natural and artificial wines, and, considering the method of manufacturing and composition of these latter, the authors' results are not surprising.

Of the ten natural wines examined, only one contained bacteria, and this one, from imperfect treatment, had always been cloudy. Wines which had been several years in bottle were sterile, containing neither yeast nor bacteria. Artificial wines contained numerous bacteria, and the authors throw out the suggestion that the presence of these bacteria may have some connection with gastric disorders.

Microbes of the Healthy Eye.†—Santos Fernandez found, from thirty-seven bacteriological examinations of the eyes of sixteen physicians and students in Habana, thirty times micrococci, five times bacilli, once *Saccharomyces*, six times *Staphylococcus pyogenes aureus*, four times *Staph. habanensis* Gibier, and twelve times *Staph. cereus albus* Passet.

Sporeless Anthrax.‡—So long ago as 1883 it had been shown that by cultivating anthrax in bouillon, to which 1/2000 of bichromate of potash had been added, the faculty of spore-formation became definitely lost, but without any diminution in the virulence of the micro-organisms: these results have been confirmed by numerous other inquirers, and recently by M. E. Roux, whose procedure is as follows:—Ten test-tubes were filled with bouillon, to which various quantities of carbolic acid had been added, the first containing 0.02 per cent., the second 0.04 per cent., and so on up to 0.2 per cent. After sterilization each tube was

* Landwirthsch. Jahrbuch. d. Schweiz, 1891. See Centralbl. f. Bakteriolog. u. Parasitenk., xi. (1892) pp. 467-3.

† Crónica médico-quirúrgica de la Habana, 1891, No. 3. See Centralbl. f. Bakteriolog. u. Parasitenk., xi. (1892) pp. 472-3.

‡ Annal. Inst. Pasteur, 1890, pp. 25-34. See Bot. Centralbl., l. (1892) pp. 57-8.

inoculated with a drop of anthrax blood, and incubated at 30°–33° for 8–10 days. In the tubes containing the most carbolized bouillon there was no growth and the bacteria were dead, while in the least carbolized there was not only growth but spore-formation.

In a number of tubes containing an intermediate quantity of carbolic acid, sporeless bacteria developed. If these last were cultivated, growth was free enough, but no spores ever developed even under the most favourable conditions.

When it is remembered that numerous bacteria have shown both physiological and morphological aberrations, such as alterations in virulence, in pigment formation, &c., in the size and arrangement of the cells, the foregoing phenomena seem to indicate that changes in the environment of bacteria may endow them with characters, morphological and physiological, differing from those of the standard by which they are recognized.

Bacillus cyanogenes, the Microbe of Blue Milk.*—M. C. Gessard propounded to himself the question whether the pigment produced by *B. cyanogenes* was one or various, and made an investigation into the conditions under which pigment was produced. He found that under natural conditions the blueness of milk is developed in association with an acid reaction of the medium, and is observed as blue bands or flakes. The addition of alkalis turns the pigment red, but on treatment with acids the blue colour returns. The author used a cultivation of the microbe obtained from Hueppe's laboratory. When this was bred in bouillon a fluorescing pigment was produced, and with egg-albumen an even better result was obtained. The addition of a few drops of acetic acid caused the fluorescence to disappear and a bluish hue to develop. This, the pigment of blue milk, is distinguishable from that of *B. pyocyaneus* in not being soluble in chloroform. It would seem that both pigments were formed in the same cultivation, and the author succeeded in breeding three different varieties, one of which produced blue pigment, the second a green fluorescing pigment, while the third was colourless.

The blue pigment is produced only when the medium is acid, and the author allowed *B. cyanogenes* to form the acid by cultivating in milk or bouillon, to which 2 per cent. glucose had been added, a beautiful blue being the result.

Lactic acid would seem to be the chief exciting influence of the production of the blue colour; for example, in the solution composed of ammonium lactate 1 per cent., neutral phosphate of potash 0·5 per cent., and magnesium sulphate 0·25 per cent., a fine blue colour is produced, while if the ammonium lactate be replaced by ammonium salts of other organic acids, only bluish or grey tones are produced. Succinic acid may, however, replace lactic acid, a result explained by the similarity of their constitution. In itself milk does not possess any special property for the formation of blue pigment, this being due to the lactic fermentation taking place therein. If this fermentation do not occur, no pigment is produced; for the mere addition of sodium lactate only produces a green pigment, and the addition of glucose, whereby an acid

* Ann. Inst. Pasteur, v. (1891) pp. 737–57. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 375–6.

reaction is induced, only a blue colour. When, however, lactic fermentation is set up in milk or when it is artificially promoted by the simultaneous addition of sodium lactate and glucose, the blue pigment is produced. In bouillon the addition of grape-sugar suffices, since here the sarco-lactic acid of muscle-juice is present.

Microbes of the Mouth and their Relation to *Leptothrix buccalis*.*—Sig. F. Vicentini makes an elaborate attempt to show that all or almost all the bacterial forms found in the expectoration are offshoots or organs of a single vegetable organism (*Leptothrix buccalis*), and that the different shapes which are assumed are in great measure due to the constitution of the nutrient medium.

According to the author's view the term micro-organism would apply to the microphyte as a whole, and bacterium, bacillus, &c., would represent particles, collections of particles, and stages in the existence of the microphyte, which have not only a separate existence but the faculty of endless repetition. It is also stated that *Leptothrix* possesses a much higher degree of organization than is usually supposed, having true reproductive organs and an elaborate method of fructification. The former method of multiplication and development is easily observable with comparatively low powers, but the latter requires special procedures and adequate optical apparatus.

The author's view of the special function of the buccal and nasal microbes seems to be that they have been placed there by nature firstly as an aid to digestion, and secondly as a defence against the micro-organisms of the external world. An identical vegetation garrisons the genito-urinary tract; hence it would seem that the human species is defended by a single microphyte which changes its form and habits according to the soil and climate in which it happens to be residing.

Human Saliva and Pathogenic Micro-organisms of the Mouth.†—Dr. G. Sanarelli concludes from a series of experiments that human saliva is a very unfavourable cultivation medium for certain pathogenic microbes, since it possesses the power of destroying them more or less quickly unless their number be too great; and that although it permits the development of certain species (*Pneumococcus*), it alters their type and renders them weak or even inert.

The saliva was obtained from various healthy individuals, and was then passed through a Chamberland's filter into test-tubes, each having 10–15 ccm. The fluid in these tubes was then inoculated from cultivations of the following micro-organisms:—*St. pyogenes aureus*, *St. pyogenes*, *Bact. Diphtheriæ*, *M. tetragenus*, *Pneumococcus*, *B. typhosus*, cholera spirillum.

Presence of *Bacillus typhosus* in Bordeaux Water.‡—M. G. Martin states that at the end of 1887, and at the beginning of 1888, Bordeaux was visited by an epidemic of typhoid fever from which 154 cases died, and in 1890 by one lasting four months, 71 cases dying.

* Atti R. Accad. Med.-Chi. di Napoli, xlv. 76 pp. (1 pl.) (separate copy).

† Centralbl. f. Bakteriol. u. Parasitenk., x. (1892) pp. 817–22.

‡ Rev. Sanit. de la Province, 1891, p. 93. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) p. 413.

Twenty-one samples of water were taken from different streets in which during the last epidemic cases of the fever had occurred, and were bacteriologically examined by Pouchet. In two specimens the typhoid bacillus was demonstrated, but in all the others no pathogenic microbes were found.

Annals of the Institute of Pathology and Bacteriology of Bucharest.*—Attention should be called to the publications of this Institute, directed by Prof. V. Babes; the first volume contains twenty memoirs, which deal with, *inter alia*, sand-filters, an epidemic peculiar to Roumanian oxen, Roumanian leprosy, and typhoid fever in the Horse.

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* Annales de l'Institut de Pathol. et de Bacteriol. de Bucharest, 4to, 1891. See Rev. Gén. des Sciences, ii. (1891) p. 454.

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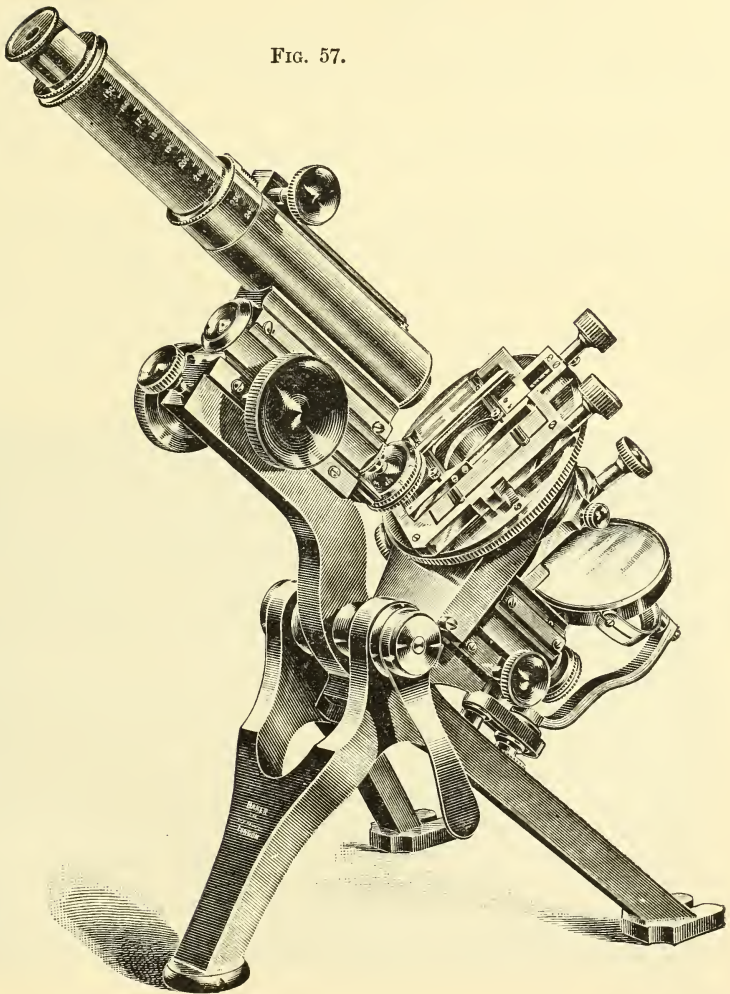


MICROSCOPY.

a. Instruments, Accessories, &c.*

(1) Stands.

FIG. 57.



Messrs. Baker's New Microscope.—Appended is a figure of Messrs. Baker's new Microscope, a description of which was given when it was exhibited to the Society.†

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous. † See this Journal, 1891, p. 867.

A New Construction for the Microscope.*—Dr. Hugo Schröder, in reference to the paper by Dr. Lendl in *Zeitschr. f. Wiss. Mikr.*, viii. (1891) p. 281, of which an abstract appeared in the last number of this Journal, has anticipated many microscopists in pointing out the fallacy involved in the conception that any real increase in the capacity of the Microscope is obtained by replacing the eye-piece of a Microscope by a second auxiliary Microscope. He also shows that the idea of such a construction has not even the merit of being new. A similar construction was originally described by Prof. Listing in Carl's *Repertorium*, v. (1869) pp. 1-5, and 134-40, and an extension of the same idea was made by Prof. Piotrowskiego,† who used Hartnack lenses partly with negative foci, and went even farther than Dr. Lendl with his (empty) magnifications.

Errors of this description were possible at a time when the diffraction theory was not generally known, but they are inexcusable now when the work of Prof. Abbe should be familiar to every microscopist. Such an arrangement as that proposed by Dr. Lendl only serves to magnify the structures in the Microscope image which have been altered by diffraction, and does not tend to give a clearer definition of any detail than can be obtained by the use of good eye-pieces. The capacity of the Microscope is not to be increased by any such simple method as this. For such a purpose processes, such as the increase of the numerical aperture, which aim at the diminution and prevention of the errors of diffraction are the only means which can give any profitable result.

An All-around Microscope.‡—Prof. S. A. Forbes writes:—"My personal studies are of a kind to require a Microscope which may be used (1) for the study of bacteria slides, (2) for the study of mounted slides of serial sections, (3) to search through and examine carefully collections of minute alcoholics in glass dishes, (4) to dissect animals under powers varying from twenty to two hundred diameters, and (5) to study pinned insects in all positions.

For the first purpose one must have a stand fitted to carry objectives of the highest power and the best illuminating apparatus; for the second, something in the nature of a mechanical stage is very desirable, but this must have a far wider sweep than the ordinary geared stage; for the third, one must be able to explore rapidly and with low power a large surface, moving back and forth along parallel lines as with a mechanical stage, but with much freer motion in all directions. The stage must also be without surface projections or attachments which would be in the way of a glass dish of considerable size.

The instrument must, further, stand erect, and yet must not be too high to work at sitting. It is a great advantage if both eyes may be used.

Fourth, for dissection hand-rests must be provided, and the Microscope must usually stand erect, and should be a binocular. Fifth, for entomological work a binocular is needed, with stage socket for insect forceps, and with a large central opening in the stage to allow

* *Central-Ztg. f. Optik u. Mechanik.*, xiii. (1892) p. 98.

† "O Mikroskopach i Teleskopach" in *Osobne od bicie*, z. xxxix. Tomu Boczu Tow. nauk. krak. ‡ *Amer. Mon. Micr. Journ.*, xiii. (1892) pp. 91-2.

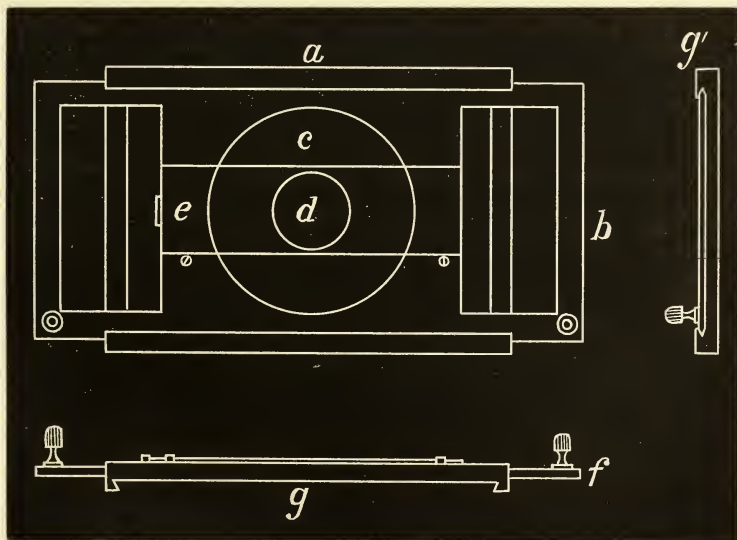
the ready turning of the object without interference of the pin or danger of injury to the specimen. As this large opening will admit light beside the condenser in bacterial work, it must be fitted with an adapter with a smaller opening. In this work, also, the rectangular movement of a mechanical stage is a great convenience for bringing insects readily into the field.

As I accomplish all these purposes perfectly by a single Microscope, it seems to me that this instrument must be adapted substantially to everything which the biologist is likely to want to do with a Microscope, and that a description of it may interest many situated similarly to myself.

My starting point is a Zeiss stand, No. 1, with oculars 1 to 5 (No. 3 being divided for the insertion of a micrometer), and objectives ranging from A_3 to an apochromatic 1-12, with the corresponding eye-pieces. For ordinary binocular work I have a Zeiss binocular eye-piece, which has the advantage over any other binocular arrangement that it does not so increase the height of the instrument as to make it inconvenient to use it with low powers while sitting.

The special feature of the instrument is the stage, which is the simplest form of mechanical movement in two rectangular directions,

FIG. 58.



adapted to the square stage of my instrument as illustrated by the engraving accompanying (fig. 58). The stage-plate of the Microscope is altered only by a triangular groove along the whole length of the lateral margin, and by an enlargement of the central aperture. Into this a heavy diaphragm may be slipped with an opening of the usual size for the Abbe condenser.

The apparatus for mechanical movement is essentially the ordinary mechanical stage, but working directly by hand instead of by rack and pinion, the especial advantage being the free long movement thus permitted. It is in two parts. A rectangular frame (*a*) showing front margin (*g*), as seen from behind, the lateral bar of which is bevelled to fit into the triangular groove in the side of the stage-plate, in which it slides forward and backward; and a thin plate (*b* and *f*) longer than the preceding and a little narrower, its bevelled edges sliding laterally in a V-shaped groove on the inner edges of the anterior and posterior bar of the frame just mentioned. The projecting ends of this plate serve as hand-rests in dissecting. Three small screws are set in it as stops for the slide, and the knobs by which it is moved are bored in the centre as sockets for the stage forceps. Its central opening is of the same size as the larger opening in the stage-plate, and in this rests loosely a circular piece of glass (*c*) with a central opening (*d*), on which a dish may be set in examining small alcoholics. This apparatus, when well fitted and smoothly ground, works with a nicety and precision scarcely, if at all, inferior to that of the geared movement. An ordinary slide in position is shown at *e*.

This stage was made October, 1890, to my order and from my drawings, by the McIntosh Optical Company of Chicago, from whom I learn that it is now furnished with many of their own instruments, being adapted to the round stage-plate of their Microscopes by placing under it a thin false stage-plate which bears beneath a socket that slips into the central opening of the stage."

Introduction to the use of the Polarization Microscope in Histological Investigations.*—This little book is intended by Dr. H. Ambronn to assist those who do not possess the physical and mathematical training necessary for understanding the more advanced works on the same subject such as those of Valentin † and Nägeli. ‡ To the mineralogist and petrologist the polarization Microscope has become an indispensable requisite, but even at the present time it is very little used by histologists. This is mainly due to the wide-spread idea that a very thorough knowledge of physical and mathematical optics is necessary in order to be able to work with this instrument. The author's aim in the present work is to give quite an elementary treatment of the subject with the hope of turning the attention of histologists to these methods of investigation. The book is thus only intended to be an introduction to the larger manuals, and accordingly only the simplest explanations are given and all mathematical formulæ are avoided.

The first four chapters of the book are devoted to an elementary discussion of the undulatory theory, the phenomena of polarization, double refraction, the interference colours between crossed nicols, and the use of the gypsum plate in determining the position of the axes of elasticity.

* 'Anleitung zur Benutzung des Polarisationsmikroskops bei histologischen Untersuchungen,' Leipzig, 1892, 59 pp., 27 figs., and 1 coloured plate.

† 'Die Untersuchung der Pflanzen und Thiergewebe in Polarisirten Lichte,' Leipzig, 1861.

‡ 'Die Anwendung des Polarisationsapparates auf die Untersuchung vegetabilischer Elementartheile,' Leipzig, 1863.

In the two succeeding chapters examples are given of the application of the methods upon cylindrical and spherical objects belonging to the vegetable kingdom, such as starch-granules, &c. The subject of pleochroism is then touched upon, and lastly a brief description is given of the methods of investigation in convergent light.

(2) Eye-pieces and Objectives.

Spencer & Smith's Aplanatic Eye-piece.*—Dr. M. D. Ewell writes:—“I have recently purchased from Spencer & Smith, of Buffalo, N.Y., a 1 in. positive eye-piece, which is so far superior to anything I have ever before used (and I have a large assortment), that I feel justified in calling the attention of microscopists to it. In common I suppose with the majority of workers, I, for a long period, paid no special attention to my eye-pieces, which, however, happened to be good ones, but centered my attention upon the objective and stand. I have long supposed that no available use could be made of any eye-piece for the micrometric purposes except in a limited portion of the centre of the field, never exceeding one-half thereof.

With the eye-piece in question I find sensibly equal amplification and no distortion, almost to the extreme edge of the field. In this respect it far surpasses the Ramsden and Huyghenian eye-pieces.

I find also that with it the definition, which I always test on a podura, is much improved, and that it is good almost to the extreme edge of the field, and this without any new adjustment of the focus. Altogether this eye-piece, which for want of a better name I shall call “Spencer & Smith's Aplanatic Eye-piece,” is in my judgment a distinct advance over existing eye-pieces. I have ordered another one for my Zentmayer filar micrometer, and propose to use it hereafter in my micro-metrical work in preference to those heretofore used.”

New Objectives.†—Mr. H. L. Tolman remarks:—“Among the new objectives recently made which are deserving of note are two, a 1/5 and 1/8 both dry, of 150°, by Spencer & Smith, or as the firm used to be known, H. R. Spencer & Co., of Buffalo. These objectives are on a new formula, and for flatness of field, freedom from colour, and sharp definition they rank very high. In fact the robust images they give so much resemble in character those of the Zeiss apochromatics that they would be indistinguishable. They work easily through a No. 2 cover, and of course have cover correction. Perhaps I am rather an enthusiast in favour of Spencer's work, but without prejudice to any one else, I say without hesitation, I never have seen better dry glasses than these. I believe there is none of the Jena glass used in them, but the chromatic aberration is most exquisitely corrected, and it is gratifying to know such correction can be made without the necessity of using the as yet unproved kinds of glass.”

Magnifying Power of Objectives.‡—Mr. H. L. Tolman offers the following remarks on this subject:—“The question of how much a given objective will magnify has always been an important, but difficult one to answer, and every assistance offered toward solving it is worthy of atten-

* Amer. Mon. Micr. Journ., xiii (1892) p. 103.

† Tom. cit., p. 98.

‡ Tom. cit., pp. 93-4.

tion. The distance of ten inches has been assumed as the proper interval between the objective and eye-piece, that being the average focal length of the normal eye, but where to measure from and to is not so easy to ascertain. Some opticians estimate from the end of the tube of the Microscope, others from the outside of the back lens of the objective, others from a point midway between the different lenses of the objective, and still others from the front end of the latter. The difference between these two extremes is fully two inches, which may cause a difference of 20 per cent. in the results. Still others choose the point where parallel rays sent through the lens from the front would come to a focus, called the posterior principal focus, and one or two others the posterior conjugate focus, still higher up the tube, a point where rays meet which emanate from another point in front of the objective, at a distance such that the size of the object and image are made equal. This is an easily established place, but a theoretical consideration of the optical principles involved shows that the only proper position from which to measure the tube length, is from the posterior principal plane of the objective. In a simple lens this is easily ascertained, and in a very thin lens can be called the centre of the lens; but in a complex combination where the distance from the front of the front lens to the back of the back lens is sometimes two inches, the exact point from which to estimate tube-length becomes important. These principal planes in nearly all converging lenses are situated inside the objective at different distances from the centre of the combination, depending on the power of the lens and the way in which the corrections are made. In two-system objectives where the magnifying power is effected nearly equally by both systems, the principal planes are near the centre of the systems, while in some high power objectives they may cross one another, the posterior plane being in front of the anterior. The principal foci anterior and posterior of a lens are also two important points to know, and when these four data are given they are all that are necessary for a discussion of the properties of a lens.

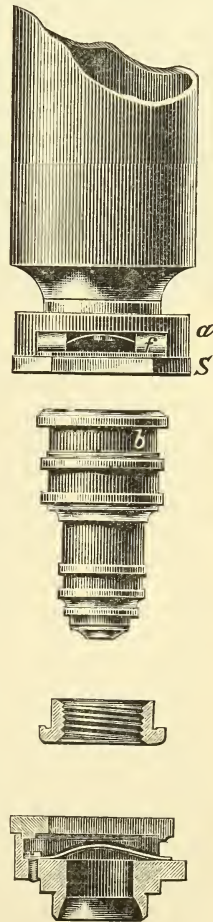
In the last Journal of the Royal Microscopical Society,* under the head of Measurement of Lenses, Prof. S. P. Thompson has given a very exhaustive and able article on how to ascertain this point or plane from which the 10-in. tube-length is to be measured. The instrument he uses is very complex and expensive, but the measurements can be made, except for high-power objectives, with a near approximation by any one with a little mechanical ingenuity. The principle of the mechanism is as follows:—The objective to be tried is placed in a horizontal position, and some point on it, either the front end or some point on the side, is selected as a zero-point for all measurements, a beam of parallel rays is sent through the lens from the back, and the distance from the zero-point to the focus F^1 of these rays measured. The lens is reversed, and the focus F^2 of the rays issuing at the back is measured from the zero-point. Then two small glass micrometers with coarsely ruled lines are placed one in front of the other behind the lens, and moved by a screw until the image of one micrometer is seen in focus on the other, and the lines superimposed. The distance of these micrometers from the zero-point is measured. We have now all the data for calculating the

* Feb 1892, pp. 109-135.

principal planes. It is a well-known optical principle that when an image of an object as shown on the screen is found to be the same size as the object, the distance between the two will be four times the focal length of the lens. In the present instance let F represent the anterior principal focus, and F^2 the posterior principal focus, obtained as above, S^1 the anterior conjugate focus where one micrometer was placed, and S^2 the posterior conjugate focus where the second micrometer was placed. Then the distance $S^1 S^2$ is equal to four times the focal length, plus the distance between the two principal planes, because an objective is not equivalent to a bi-convex lens. To get the difference between the principal planes it is only necessary to subtract the distance $S^1 S^2$ from twice the distance between the anterior and posterior principal foci.

Now, to find where these planes are, take the distance from the front focus or anterior principal focus to the micrometer, this is the true focus, and measure it backwards towards or along the objective, it will fall in the tube, perhaps a quarter of an inch from the front end; this is the first principal plane. Then measure from the back focus or posterior principal focus to the other micrometer, and that will be the distance to lay off on the tube from the back focus toward the front end of the objective; mark it on the tube, as it is the much-desired posterior principal plane from which the 10 in. is to be measured. To ascertain all this practically perhaps seems hard, but it is not very difficult to get very close measurements. A low-power objective should be chosen, and laid on a piece of cork along the edge of a board or table. For micrometers, take a stiff piece of writing-paper, and rule a series of lines $1/50$ in. apart, using a Brown and Sharp's steel rule as a guide; cut this paper across the lines so as to make two micrometers, thus securing uniformity in the lines, as if each micrometer was ruled separately the lines might not agree. Dip these papers in oil or hot paraffin to make them transparent, and mount in a slit in a piece of cork at such a height as to be able to see them through the objective. Take all measurements with a pair of callipers, and lay them off on a rule. One ought to be able to get the principal planes within $1/50$ in., and five times this would only make an error of 1 per cent. in the tube-length."

FIG. 59.



New Arrangement for the Quick Change of Microscope Objectives.*—Herr H. Boas describes a simple form of adapter which can be applied to any Microscope model, even to small

* Zeitschr. f. Instrumentenk., xii. (1892) 162-4.

instruments, in which the coarse-adjustment is by sliding socket. It is intended to replace the popular revolver which is so inconvenient when any manipulation of the preparation has to be made on the stage.

In fig. 59 the new adapter is represented $\frac{4}{5}$ of its actual size. The adapter proper *a* is screwed in the ordinary way upon the body-tube instead of a system, while the objective to be used is provided with a connecting ring, the front edge of which fits exactly into a groove in the plate *S*. This plate is open on one side, in order to admit the neck of the connecting ring. A steel spring *f*, in the shape of a horse-shoe, screwed into the interior of the main-piece, serves to press the ring firmly into the groove. The plate *S* is attached to the main-piece *a* by four screws in such a way that an exact centering of the ring with the objective attached to it is insured.

Paper for Cleaning the Lenses of Objectives and Oculars.*—The so-called Japanese filter-paper (the bibulous paper often used by dentists when filling teeth) is recommended for cleaning the lenses of oculars and objectives. It is said to be more satisfactory than cloth or chamois, because dust and sand are not present, and its bibulous character makes it very efficient in removing liquid or semiliquid substances. Use it for removing immersion-fluid from objectives, cloudiness or dirt from eye-pieces, glass slips, or thin glass. Water, glycerin, or other fluids can be removed. Another recommendation is its cheapness.

(3) Illuminating and other Apparatus.

Use of Polarization-Photometer.†—Dr. S. Czapski discusses the arrangement of the sections in the polarization-photometer so as to obtain achromatism of the bounding line without achromatism of the calcite prism. He explains how necessary it is in the use of photometers of any kind that the faces of which the brightness is to be compared should have a sharply defined line of boundary.

In polarization-photometers the usual arrangement consists in producing by double refraction two images a_o, a_e and b_o, b_e respectively, of two apertures *a b* situated at one end of the apparatus at a determined distance *d* apart. The magnitude of the double refraction bears such a relation to the distance of the apertures, that a_o and b_o are exactly adjacent, as seen in fig. 60.

Since refraction is accompanied by dispersion, the edges of the images a_o and b_o have coloured seams, and since the dispersive power of calcite is essentially different for the ordinary and extraordinary ray, simultaneous achromatism of both images is impossible. The most that can be done in this direction is to use, for the partial achromatism of the calcite prism, a flint glass with dispersive power lying between that of the ordinary and extraordinary ray in calcite, and thus to distribute the unavoidable chromatism uniformly over both images. In this case accordingly there remains a primary coloured seam on both boundary lines, which renders judgment of the brightness of the two fields difficult.

The author proposes to remove this coloured seam by the very simple but ingenious device of arranging the apertures, not sym-

* Amer. Mon. Micr. Journ., xiii. (1892) pp. 99-100.

† Zeitschr. f. Instrumentenk., xii. (1892) pp. 161-2.

metrically, as in fig. 60, but in such a way (fig. 61) that the boundary lines fall in the plane of the double refraction. By this means the ordinary image A_o of the one aperture is formed above the extraordinary image B_e of the other, and no coloured seams appear on the boundary lines, for the simple reason that no deviation nor dispersion takes place in the direction at right angles to these lines.

FIG. 60.

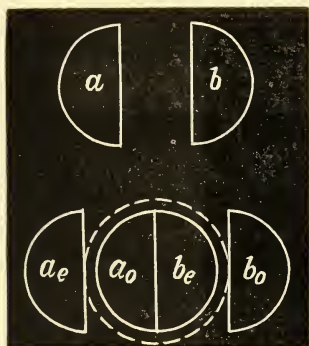
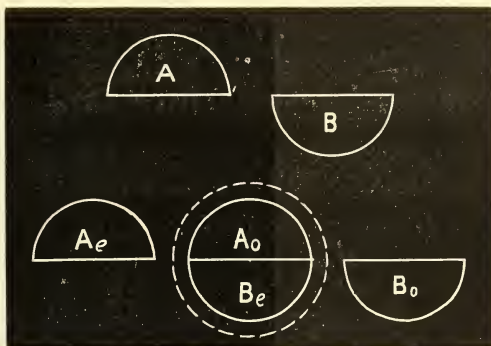


FIG. 61.



For the same calcite prism, in order to obtain the right effect, the apertures $A B$ (fig. 61) must be chosen smaller or closer together than the apertures $a b$ (fig. 60). But since in this new arrangement no achromatism (and consequent diminution of deviating effect) of the calcite prism is necessary, the deviation by double refraction can be made essentially greater than in the first case, so that apertures really larger and farther apart than in the ordinary apparatus can be used.

The arrangement here described can be applied to all apparatus in which the juxtaposition of the ordinary and extraordinary images of two apertures is effected by double refraction.

A Revolving Table.*—The following is an account of Mr. F. L. Morton's device:—

I. Saw out a circular board 18 in. in diameter, and ornament the edge if you choose. On the under side, and about 2 in. from the edge, place four castors equidistant, and have the board rest firmly on them. In the centre of the under side bore a hole nearly through the board and insert a piece of brass tube. Stain or paint the board at pleasure.

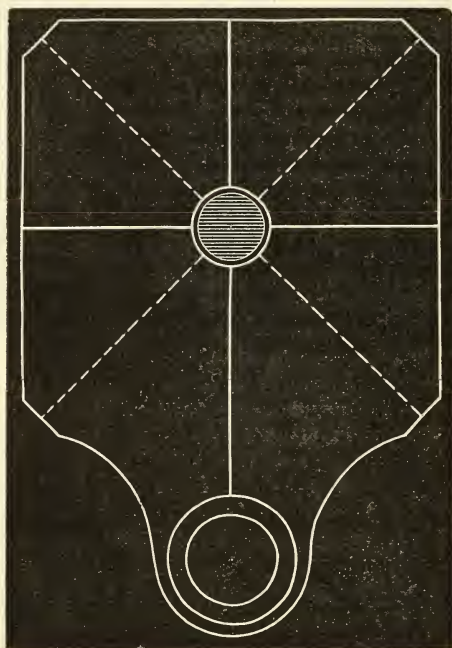
II. Cut a piece of thick pasteboard 18 in. square and to the centre of it fasten a block 2 × 2 in. by 1 in. thick, letting a brass pin stick up an inch from its centre, having it of such size as to work loosely in the tube.

III. Place the second apparatus on a small stand or table, adjust the first apparatus over it so that the pin will fit into the tube, revolve the top part upon the pin as a centre guide and upon the castors as lateral supports. If the castors are noisy make a track with felt for them to run on.

* Amer. Mon. Micr. Journ., xiii. (1892) p. 120.

A simple Geometrical Indicator for the Microscope.*—Dr. Pietro de Vescovi describes a new form of indicator which has the advantage over those in general use of great simplicity and general applicability to any Microscope. It consists of a simple system of four straight lines (see fig. 62), traced on the stage of the Microscope, which virtually intersect in the projection of the optical centre of the field of view in such a way that each line is at 45° to the next.

FIG. 62.



In order, with this system of lines, to mark and recover the position in a preparation of an interesting point, the slide is held firmly or pressed against a projecting piece on the stage and a light mark is made with ink at three points on three adjacent lines of the system. The point of interest can at any time be again brought into the field of view by bringing the three points marked upon the slide upon the three adjacent lines of the system.

The author would recommend Microscope-makers to engrave this system of lines on the stages of their instruments in white and red alternately on a black ground.

FRIEDRICH, P.—Eine Heizvorrichtung des Mikroskopes zu bakteriologischen Untersuchungen. (On a Heating Arrangement for the Microscope in Bacteriological Investigations.)

Arb. a. d. k. Gesundheits.-A., VIII. (1892) No. 1, pp. 135-9.

* *Zool. Anzeig.*, xv. (1892) pp. 203-5.

(4) Photomicrography.

Photographing Bacteria.*—Sir H. E. Roscoe and Mr. J. Lunt describe a method of photographing bacteria, which they say is very simple and requires no special apparatus or “microscopic accessories.” The arrangement of the apparatus is shown in fig. 63.

A common duplex paraffin oil lamp was the source of illumination. As methyl-violet was the stain employed and as this transmitted actinic rays of light a screen was spectroscopically adjusted to the stain employed, and a weak solution of potassium bichromate was found to serve the purpose admirably. The stained bacteria appear black on a bright yellow background. The photographic plates employed must, therefore, be sensitive to yellow light.

Abbe's condenser was used, without diaphragm, and was focused rather farther from the object than for ocular examination. A simple clip stage was employed without mechanical accessories. The microscopic preparations were ordinarily obtained from young pure cultures, thus securing cells full of protoplasm, which stain deeply, an essential for actinic contrast on the photographic plate. Canada balsam in xylene was uniformly employed as a mounting medium. The lenses used were Leitz' $1/12$ oil-immersion for 740 diameters, Zeiss' D for 370, and Zeiss' A for 100 and 50 diameters. No eye-piece was used, nor was there any lens in the camera, which was connected to the tube of the Microscope by a horizontal dark box extension. Edwards' isochromatic plates

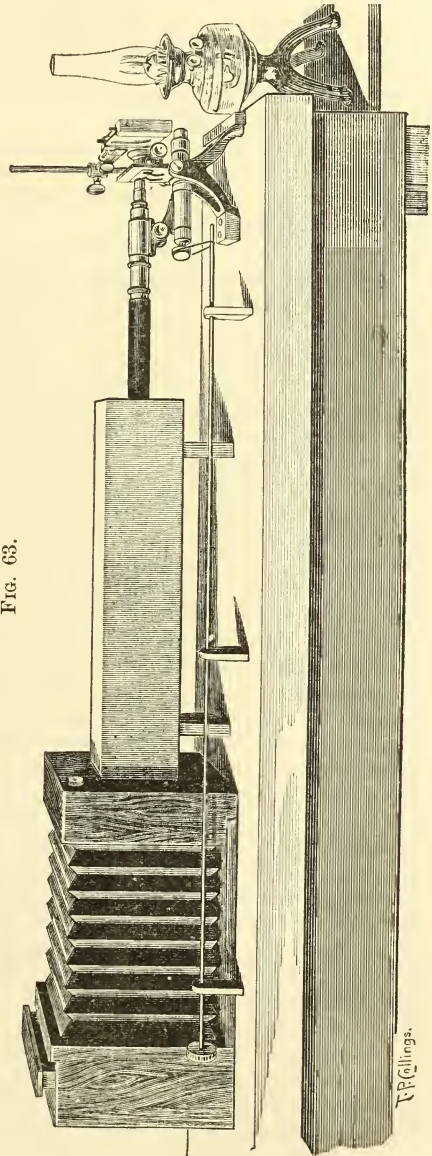


FIG. 63.

* Phil. Trans., 182 B (1892) pp. 642-4.

were used throughout. For the image shown by the immersion lens the exposure was about $1\frac{1}{2}$ minutes, with correspondingly shorter exposures for Zeiss' A and D.

(6) Miscellaneous.

Ink for Writing on Glass or Porcelain.*—The 'Rundschan' (Prague) gives the following:—Dissolve in the water-bath 10 parts bleached shellac and 5 parts Venice turpentine in 15 parts oil of turpentine. Incorporate in the solution 5 parts of lamp-black. So-called diamond ink for writing on glass is a compound of fluoric acid and barium; the latter has no effect, it being simply a white powder to give body to the acid. The ink can be used with a rubber hand-stamp, and it should be allowed to remain fifteen minutes, when the barium will brush off, leaving the design on the glass.

Spherical Aberration—Achromatic Objectives.†—Mr. Lewis Wright writes as follows: "Allow me to draw attention to another subject which vitally interests English microscopic opticians—viz. the production of apochromatic objectives. Though some of them have managed to secure a little supply, others are painfully aware that before the use of fluorite was allowed to become public, all the known available material had been secured by the firm of Zeiss at Jena; and the difficulty of getting material experienced by some of our best makers is a formidable obstacle to optical improvement, and tends to artificially keep up the prices. From an American periodical lent me by Messrs. Watson and Sons, I see that Prof. J. Brun has recorded in the 'Journal de Micrographie' the success of M. Albert Brun in producing by chemical synthesis what is called 'artificial opal,' and which is stated to have almost exactly the optical properties of fluorite, but to be harder, more homogeneous, and better suited for optical working. It is also stated that the process produces pieces large enough to be conveniently used in the manufacture of optical instruments. But this is the point. Prof. Brun apparently quotes from 'Archives des Sciences Physiques et Naturelles,' of Geneva, June 1891, and further quotes from it, or else states himself, that '*the house of Carl Zeiss, at Jena, has acquired the right to manufacture and to use this artificial opal for optical purposes.*'

I think microscopical opticians have a right to ask what this means. It may mean no more than that the Jena firm has purchased a right to use this newly-available material, which is fair enough; indeed, I am such a baby as regards patent law, that I am not even sure whether or not a really international monopoly can be thus bought and sold. But if, as on its face appears, it is here meant that the German house has also effected a monopoly of this artificial process, or attempted to do so, and thus to obstruct the fair play of competition and march of improvement, the sooner such a peculiarly German method of business is generally understood by microscopists the better. I sincerely trust the affair is one of only clumsy translation, and that some one authorized to speak on behalf of Messrs. Zeiss will be able to dispel any such suspicion, which would assuredly do them more harm in the long-run

* Amer. Mon. Micr. Journ., xiii. (1892) p. 110.

† English Mechanic, lv. (1892) pp. 220-1.

than any possible temporary advantage to be secured in such a peculiar way."

Dr. S. Czapski,* in reference to Mr. Wright's letter, writes:—"Having read Mr. Lewis Wright's extraordinary letter (33427) in No. 1414 of the 'English Mechanic' on the subject of the employment of fluor spar in apochromatic lenses and the substitution for it of artificial opal obtained by Mr. Brun's method (vide 'Archives des Sciences Physiques et Naturelles,' t. xxv. No. 6), I will attempt to satisfy his curiosity by the following statements.

As regards fluor spar, Mr. Lewis Wright is labouring under a great delusion in assuming that before the use of fluorite was allowed to become public, all the known available material had been secured by the firm of Zeiss at Jena. The contrary may be said with more truth. The firm of Zeiss possessed but a very scanty supply at a time when, even previous to Mr. Koristka's groundless attacks in the 'Journal de Micrographie,' the fact that fluor spar was being used in the apochromatic lenses had been published three times in consequence of information supplied by the firm of Zeiss.

The latter were completely prepared to produce their future apochromatic lenses without having recourse to fluor spar, which by no means constitutes the condition *sine qua non* for the production of apochromatic objectives, excepting, of course, in the case of such opticians who can only produce them by slavishly copying existing systems. As, however, the firm became eventually possessed of a considerable quantity of clear material the employment of fluorite in their apochromatic lenses was continued.

But as regards the artificial opal of Mr. Brun, it is, in the first place, quite erroneous to treat it as a substitute for fluor spar, for though its refractive index is comparable to that of fluor spar (for fluor spar, $\mu_D = 1.434$; for opal, $\mu_D = 1.450$), yet the relative dispersive powers are markedly different—viz. $\frac{\mu_D - \mu_G}{\mu_D - 1} = \frac{1}{95.4}$ for fluor spar, and $\frac{1}{67.2}$ for opal. With the latter the dispersion is, therefore, even greater than that attainable with phosphate glasses. For this reason the firm of Zeiss wrote about eighteen months ago to Mr. Brun:—

'That they had abandoned their original hope of a glass to be produced by Mr. Brun of exceptionally low relative dispersion, and that there remained, therefore, only an exceptionally low refractive index. It became now a question of determining in what department of practical optics a substance possessing these properties might yield particular results, which were not obtainable with other glasses. For as in any case the production of your glass will involve greater difficulties, and probably also higher costs, than is the case with silicate glasses (which also admit of the value of $\frac{\mu - 1}{\Delta \mu}$ being reduced to about 65), and as the production of *large* pieces (e.g. for telescopes and large photographic objectives) is very likely to cause considerable—perhaps insurmountable—difficulties, it would become necessary to determine those cases in which its characteristic property, the very low refractive index, con-

* English Mechanic, lv. (1892) p. 287.

stitutes an advantage sufficiently great to compensate for the difficulties of its application.

We have, with respect to this question, had to investigate the subject by special calculations, no one being in a position *a priori* to answer it. These investigations have, however, hitherto not led to any *positive* results. It remains, in fact, still highly problematic whether there be any problem in practical optics the solution of which may be approached by the existence of a glass possessing the characteristics of the artificial opal.

Nevertheless, the substance in question interests us in a high degree. We recognize in its appearance a valuable attempt to extend the range of optical means, and an incitement for new studies in the production of artificial glasses. As we ourselves, in conjunction with Dr. Schott, have worked in this direction for a period of ten years, and intend to continue our researches, the outcome of *your* experiments is indeed full of interest to us, quite irrespectively of the question whether your material affords a means of immediate practical application or not. For this reason we entertain a wish of at least rendering your researches available for continuation in our own experiments in glass smelting.

We make to you, therefore, the following proposition:—

We offer you to defray the expenses of your past experiments (. . . francs), provided you agree to communicate to us the composition of, and manner of, fusing your glass with such exact and complete directions as to enable Dr. Schott to reproduce it in his laboratory. We further stipulate that you place in our hands a few samples of the material obtained by yourself enabling us thus to at once proceed with experiments on its properties; that you authorize us, or Dr. Schott, to compound your glass according to your directions, in order that we may obtain material for practical *experiments*, and also to utilize the process indicated by you in researches aiming at the production of other similar glasses.

It is to be understood that you retain all rights as to priority, in particular the right of publishing your experiments, inclusive of the composition of your glass and the mode of fusing it, before we publish anything on the subject or make any attempt to utilize the glass commercially. It is, however, to be agreed that you promise to suspend such communications to others on the compositions and production of the glass *for one year*, in order that, in the meantime, we may find sufficient time to exhaustively investigate the matter.

As this proposition agrees entirely with the first offer which you made in your letter of the 28th Sept., excepting only that in the present proposition we cede to you further rights which we do not consider ourselves justified in claiming for ourselves, we assume that the above will meet with your approval.

And after having received the desired communications from Mr. Brun, the firm of Zeiss wrote again:—

‘We should consider it very inappropriate to any longer insist upon your continuing to keep secret the general results of your studies—i. e. the artificial production of amorphous silica and the establishment of its optical character. These results are of such great scientific interest that you should, in order to establish your priority, forthwith publish them. *Our* interest in the continuation of your work would thereby not be affected in the least. In fact, had even those results been published

by you previous to the formulation of our agreement, the same proposal would have been made by us. We only stipulate that you should, for the present, exclude your personal experience regarding methods and means from publicity, and that in your publication you mention that the firm of C. Zeiss, in Jena, has undertaken to render your experiments, if possible, available for the requirements of practical optics. (The numerical values of μ and $\Delta\mu$ very nearly agree with the result obtained by spectrometric measurement by Dr. Abbe years ago with respect to several varieties of natural opal.)'

These extracts will show Mr. Wright how much truth there is in his statements with respect to the monopoly of the German house. I emphatically endorse his remark 'the sooner such a peculiarly German method is understood by microscopists the better.' True, if he means the better for the firm of Zeiss.

In order, however, that Mr. Lewis Wright may be freed from any vestige of a doubt, the firm of Zeiss offer to place at his command all communications which they have received from Mr. Brun, and they offer him a premium of 1000m. if he will pledge himself to supply within the period of one year 160 grammes of optically useful opal produced after the method of Mr. Brun.

If Mr. Wright be not equally a 'baby' in technical processes, as he confessedly is in matters pertaining to patent law, he will find it an easy task to merit the premium offered to him, and to enrich the stores of technical optics by such a valuable material."

To this letter Mr. R. Kanthack adds the following:—"The above letter of Dr. Czapski (which, by the way, is a translation, and should, in fairness to the original writer, be read as such) will no doubt be sufficient to remove Mr. Lewis Wright's doubts; but it may not be uninteresting to him to hear that within the last eighteen months respectable quantities of fluorite were offered me in my capacity as agent of the firm of Zeiss. The fact, however, that the price offered almost ridiculed [*sic*] the price expected—so much so, that in one case it was thought more profitable to utilize the fluor spar for garden decorations—agrees but imperfectly with the allegation that the firm of Zeiss is bent upon securing all existing fluorite mines. Summing up Dr. Czapski's explanatory statements, it would appear that for the construction of apochromatic lenses fluorite is 'useful,' but mathematics 'indispensable.' I may here mention that it is only due to want of appreciation of the *mathematical* principle of apochromatism that the terms 'semi-apochromatic lenses' and 'apochromatic glasses' (the latter as applied to the raw material produced by the Abbe-Schott process) retain their scientific sound, when in reality they can claim no more meaning than that attachable to trade advertisement."

B. Technique.*

Zimmermann's Botanical Micro-technique.† — We have here a much-needed handbook of microscopical preparations, chemical reactions,

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† 'Die Botanische Mikrotechnik,' von Dr. A. Zimmermann, Tübingen, 1892, x. and 278 pp. and 63 figs.

and methods of staining. It is divided into three sections. The first treats of general methods, the examination of dried plants, maceration, swelling, clearing, methods of fixing and staining, &c. The second part discusses micro-chemistry, and the reagents for the various substances found in the vegetable kingdom. In the third section we have a detailed treatise on the methods of investigation for the cell-wall and the various inclosed substances, and for the differentiation of the protoplasmic constituents. A supplement treats of the methods of investigation of bacteria; and the whole concludes with a copious bibliography and a very full index. The wood-block illustrations, both those which belong to the first part, and those which depict the appearances presented under the Microscope by the use of reagents, are exceedingly good and clear, most of them new.

(1) Collecting Objects, including Culture Processes.

Automatic Device for Rolling Culture Tubes of Nutrient Agar-Agar.*—Prof. G. F. Atkinson describes a process which he has found successful for rolling culture-tubes of agar-agar under a continuous shower of cold water instead of using ice for the purpose. The apparatus consists of a tin jacket, with rectangular perforations and bristling with "paddles," which grasps the tube, and upon which the stream of water is so directed that it furnishes not only the motive power for whirling the tube, but also the cold bath to solidify the agar-agar. The mode of making and using the jacket is described in detail.

Bacteriological Technique.†—Dr. G. H. F. Nuttall says that in many cases the ordinary loop made of platinum wire does not work well because it bends, and advises the use of a stiffer instrument such as he has invented. This resembles a small spear, is made of wire 1 mm. thick, beaten out at the free end into a triangular flattish extremity, in the centre of which is a teardrop-shaped perforation (see fig. 64).

FIG. 64.



(2) For examination of drop cultivations the author advises the following method which is very convenient and less tiring to the eyes than that in vogue, as by its adoption focusing is much facilitated.

A thin black ring composed of lampblack and blood-serum is run round a cover-glass by means of the turntable. The cover-glass is then sterilized in the usual manner and the drop placed in the middle of the ring. As it is easy to focus the ring and as the organisms lie in the same plane, the latter are easily found by merely pushing the preparation along.

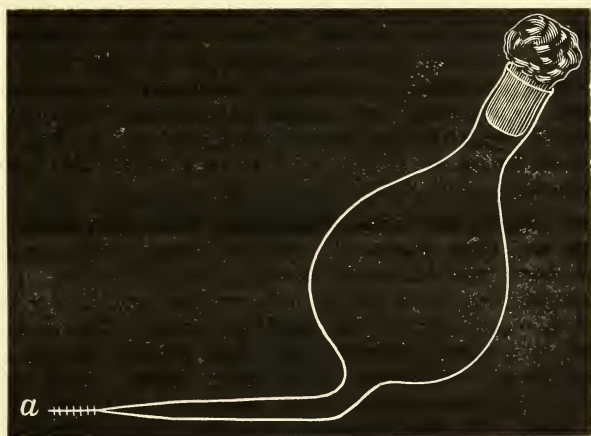
(3) Test-tubes may be closed with flat discs of paraffin made by

* Bot. Gazette, xvii. (1892) pp. 154-6 (1 pl. and 1 fig.).

† Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 538-40 (2 figs.).

punching out pieces from a paraffin plate. The discs should have a diameter a little larger than that of the test-tube. They may be sterilized in sublimate and kept covered up ready for use. When required they are warmed a little and the cotton-wool plug having been burnt and removed, the disc is inserted and jammed into the opening so that

FIG. 65.



the tube is now hermetically sealed. In case tubes thus prepared are to be kept at a higher temperature the cap is perforated in order to allow the gas or air to escape, and the hole afterwards sealed up with fresh paraffin.

(4) Blood-serum is obtainable very satisfactorily in the following manner. The flasks (fig. 65) may be made of any size and to hold 10-100 cm. or more. The broader of the two tubes is plugged with cotton-wool, while the other is drawn out to a fine point and closed.

The artery, from which the blood is to be drawn, having been exposed is tied in two places. The ligature farthest from the heart is drawn tight, while the proximal ligature is merely loosely tied; just above this the artery is clamped. An opening is then made between the two ligatures and the thin tube of the flask (its end having been broken off) is inserted into the artery, and the loose ligature drawn tight so that it holds both tube and artery. The clamp is then released. When sufficient blood is obtained the artery is compressed, and the apparatus having been withdrawn the fine tube is sealed up in the flame. In this way 2-3 flasks full may be obtained from each animal, and with a strong probability that they will be sterile. After coagulation the serum may be withdrawn with a pipette.

Preserving Malaria Parasites alive.*—In a case of typical tertian ague, Dr. O. Rosenbach put a leech over the spleen; this died in 48 hours and numerous dead plasmodia were found therein. Two other leeches

* Berlin Klin. Wochenschr., 1891, No. 34. See Centralbl. f. Bakteriologie u. Parasitenkunde, x. (1891) p. 806.

were applied some hours before the beginning of an attack, and one of these, opened 24 hours later, was found filled with red corpuscles inclosing living plasmodia and mobile pigment; the other leech was opened 48 hours after sucking, and the appearances seem to have been quite similar. A leech applied 24 hours after treatment with quinine was found to contain a few shrunken plasmodia and a little immobile pigment.

It would seem therefore that the malaria parasites can be kept alive within the leech for at least 48 hours, and this retention of life suggests that the leech might be employed for studying the life-history of the plasmodia. It would be satisfactory to ascertain if the blood drawn by the leech were capable of infecting other animals.

The author suggests that human blood rendered artificially coagulable by leech substance might be used as a cultivation medium for malaria parasites.

Tubercle Bacilli and other Pathogenic Micro-organisms found in the Sputum and Lung Cavities.*—Mr. S. Kitasato obtains pure or approximately pure cultivations of tubercle bacilli from the sputum by making the patients, after having well washed out their mouths, expectorate into capsules filled with sterilized water. The sputum must be coughed, not merely hawked up. The selected lumps are then washed ten times successively in so many vessels filled with sterilized water. Cultivations are then made on agar and often these are quite pure. It was remarked, however, that cultivations from the sputum differ at the outset of their growth from those obtained from tuberculous organs. For the first two weeks they appear as circular white opaque flakes on the surface of the agar, and the colonies are furthermore distinguished by being moist, smooth, and shining (almost like colonies of white yeast) while those from the organs are dry, dull, and wrinkled.

By about the fourth week these differences disappear, the two sets of colonies becoming indistinguishable.

The author then goes on to state that most of the bacilli in the sputum and in the contents of lung cavities are dead, although microscopically they are exactly alike. This was proved both by cultivation and injection experiments.

From observing the constant association of other bacteria and their presence in considerable numbers, the author concludes that these other micro-organisms exert some influence on the disease, but to what extent is uncertain.

Preparation of Sterile Gelatin Tubes.†—In their researches on the chemical bacteriology of sewage, Sir H. E. Roscoe and Mr. J. Lunt prepared gelatin tubes in a manner which they say is simpler and shorter than that generally adopted. The test-tubes, 5 or 6 in. \times $\frac{3}{4}$, are first washed and set up on end to drain, and then heated to 150° for an hour. Pure cotton-wool is placed in a steam sterilizer and subjected to a current of wet steam for two hours, and afterwards dried in the hot-air sterilizer by heating to 150° for half an hour. This

* Zeitschr. f. Hygiene, xi. (1892) pp. 441-4.

† Phil. Trans., 182 B (1892) pp. 662-4.

method gives a whiter wool without brittle and partly charred thread, and by it tubes can be prepared in one day. When about half a gross of tubes have been plugged they are replaced in the hot-air sterilizer and raised to 150° for an hour.

To prepare sterile nutrient gelatin, one pound of lean beef is finely minced, and a litre of tap water is poured over the mass; the whole is placed in the steam sterilizer for an hour and a half, and is then filtered into a large beaker containing 100 grm. of gelatin, 10 grm. of peptone, and 5 grm. of salt. The hot filtrate quickly dissolves the gelatin. The mixture is now placed in the steam sterilizer for half an hour, neutralized with potassium carbonate, or replaced in the sterilizer for another hour. The turbid fluid is now filtered into a large flask and distributed to the sterile plugged tubes; these are now steamed for fifteen minutes, and the steaming is repeated on the second and third day for ten minutes each day. This treatment is quite effective.

Before opening the tubes the tuft of wool was uniformly singed to burn up the dust and germs which might have fallen on the outside. In the preparation of sterile peptone broth the only difference is that the 100 grm. of gelatin are omitted. For sterile agar-agar 20 grm. of agar are used instead of 100 grm. of gelatin. Petri's dishes (shallow covered glass dishes about a decimetre in diameter and 15 mm. deep) are much more simple to work with and give less contamination from the air than the original glass plate and bell-jar method.

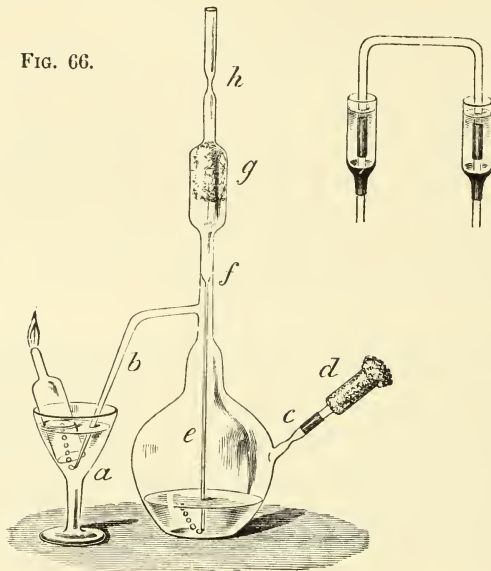
Investigation of Chemical Bacteriology of Sewage.*—Sir H. E. Roscoe and Mr. J. Lunt adopted the following method for the isolation of anaerobic organisms. They devised a special form of cultivation flask (fig. 66) suitable not only for mixed cultures, but also for pure cultures, in which the organisms can be grown in an atmosphere of pure hydrogen.

The flask is furnished with a capillary tube *e*, sealed in at *f*, for the purpose of introducing hydrogen. A firm plug of sterile wool at *g* excludes foreign germs. When it is desired to sterilize the flask and its contents before the introduction of pure material or sewage, the fine jet *a* is sealed, and the opening *c*, for the introduction of the culture fluid and organisms, is protected by a sterile plug *d*. The whole is steamed for twenty minutes on two or three successive days, and is then ready for use. The plug *d* is carefully removed, and a few drops of sewage are introduced by a freshly drawn out capillary pipette, after which the tube is sealed at *c*. Pure hydrogen is now passed through the liquid by means of the capillary tube *e*, the gas issuing by the broken off end of tube *a*, immersed in water to shut off all communication with the air. After the gas has passed for half an hour and every trace of oxygen is expelled, the flask is hermetically sealed at *h* and *b*.

For the isolation of spore-forming organisms the following method was used; a few drops of sewage were introduced into a sterile broth tube by means of a recently drawn out capillary pipette, and the plug was replaced. The tube was then plunged into water at 80° for ten minutes; this suffices to kill all the full-grown bacilli, but is not

* Phil. Trans., 182 B (1892) pp. 635-7.

sufficient to kill the spores. The spore-forming organisms may now be isolated by plate culture.



Bacteria Harpoon.*—Dr. Unna has devised an apparatus for fishing out bacteria from minute and particular colonies. It is called a harpoon and the idea of the inventor was to replace an objective by a needle. Hence the apparatus is intended to be fitted on to the Zeiss sliding objective-changer. The harpoon is constructed of a tube of metal, the proximal end being threaded to screw into the slide and the distal split in order that a needle may be inserted. The needle is fixed in position by means of a screw.

The instrument is manipulated in the simplest manner. First, it is necessary to ascertain if the search-lens and the harpoon are centered. This is done by means of a cross-thread ocular, and if a hole made by the needle-point, say, in the cultivation plate, centres accurately with the crossing-point of the threads, then the desired colony is placed in the exact position; the lens is exchanged for the harpoon, the point of the needle is screwed down on the colony; then having been screwed up the harpoon is removed, the inoculation made, and then the needle disinfected and so on.

It is obvious that the only difficulty in working this apparatus arises in connection with the centering of the search-lens and the needle, and this, as the author says, is for the microscopist a trivial affair.

Strauss' Method for quickly Diagnosing Glanders.†—Herr G. M. Finkelstein records a series of experiments made for the purpose of

* Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 278-80.

† Tom. cit., pp. 433-8.

diagnosing the presence of glanders in horses by Strauss' method, a method which consists in injecting some of the suspected glandered tissue, or of cultivation from this into the peritoneal sac of male guinea-pigs. One of the principal results of this method is an affection of the testicle and its coverings, which is observable two to three days after inoculation. The skin of scrotum is tense, red, slimy; suppuration often occurs, and in the pus may be found the bacilli of glanders. The animals die in from four to fifteen days. Both the tunica vaginalis and the body of the testicle are affected.

The method would seem to be both easy and effectual for diagnosing glanders, for if the testicles of an animal become inflamed on the second or third day after intraperitoneal inoculation, the presumption would be that the disease is glanders.

The glandered material was derived either from the nasal secretion or from a piece of the submaxillary gland; these were either inoculated on some cultivation medium, or were rubbed up with bouillon or water and then used directly as an injection.

ARONSON, H.—Ueber die Anwendung der colloidalen Thonerde zur Filtration bakterienhaltiger Flüssigkeiten. (On the use of Colloidal Clay for the Filtration of Fluids containing Bacteria.) *Arch. f. Kinderheilk.*, XIV. 1891, pp. 54-8.

(2) Preparing Objects.

Investigation of Structure of Pancreas.*—Prof. C. J. Eberth and Dr. K. Müller used the pancreas of freshly killed animals. They preserved the organ in Flemming's or Rabl's mixture, or in Hermann's fluid; in Flemming's mixture, 1 per cent. solution of platinum chloride took the chromic acid. Good results were also obtained by the use of a 1/3 per cent. solution of platinum chloride and Kleinenberg's picrosulphuric acid. The secondary nuclei were not well shown when fixation was effected with corrosive sublimate. The hardened glands were imbedded in celloidin or paraffin; the latter is better for those animals in which the cells are smaller than in Amphibia. Care, however, must be taken in making the sections. Hæmatoxylin with eosin, Platner's nucleus-black, Ogata's hæmatoxylic eosin, nigrosin and saffranin were among the staining reagents; Babes' safranin-anilin-oil is recommended.

Examination of Ectoparasitic Trematoda.†—Herr C. Dieckhoff finds that little is to be learnt from an examination of living Trematoda. The worms were generally killed by heated solution of corrosive sublimate, but in a few cases chrom-osmic-acetic acid or Müller's fluid was used. The objects were hardened in alcohol or Müller's fluid, and were all stained with picrocarmine. The serial sections were 0·01 mm. thick.

Preparation of Epiphytic Fungi.‡—For preserving the various parts of epiphytic fungi in their natural position while under examination under the Microscope, M. A. Gaillard recommends the following process. A drop of collodion is first of all dropped on to the fungus; but the

* *Zeitschr. f. Wiss. Zool.*, xxxv. Suppl. (1892) pp. 119 and 20.

† *Arch. f. Naturgesch.*, lvii. (1891) pp. 247 and 8.

‡ *Bull. Soc. Mycol. France*, vii. (1891) pp. 233-4. See *Bot. Centralbl.*, l. (1892) p. 75.

collodion of commerce does not form a sufficiently homogeneous pellicle; and the author recommends the following preparation:—gun-cotton 4 grm., 90 per cent. alcohol 10 grm., sulphuric ether 32 grm., castor oil 2 grm., lactic acid 2 grm. The lactic acid insures clarifying of the hyphæ. When the ether has evaporated, this collodion leaves behind a remarkably delicate pellicle, which must be carefully removed, carrying the fungus along with it. The cellulose is then again dissolved off by a drop of a mixture of 90 per cent. alcohol and ether, the glass slide heated, and a small piece of glycerin-gelatin placed on the preparation; this at once liquefies, and incloses within it the fungus with all its parts in their natural position.

Preparing and Examining Hyphomycetes.*—One of the simplest methods for examining spore-formation on aerial hyphæ is, says Dr. Unna, to use a cell-slide and to fill the cell with nutrient agar. When the medium has set, one-half is to be cut out and the fungi grown on the remaining half. Under these conditions pretty high powers may be used for examining the fungi and their growth. But a more effective and even simpler method is to grow the fungi in a test-tube and observe them *in situ*. On obliquely set media a cultivation track is made not only along the middle, but also along the edge where it joins the glass. This allows, especially if the glass be very thin, the cultivation to be well seen. This method allows of numerous modifications; for example, the cultivation having grown up, most of the medium may be got rid of by gently heating it, and then when liquefied, pouring it off, thus leaving only a thin layer, on which the growth is left behind. These “minimal cultivations” are very superior to all other methods for observing the various stages of growth, and a pure cultivation may be thus kept under observation for weeks or months.

The cultivations may be fixed and stained by the following method. The test-tube is filled in with the following mixture:—gelatin 1, liq. ammon. fort. and spirit equal parts 25·0, glycerin 15·0, distilled water 35·0. This moistens the fungi, drives off air-bubbles, renders the minimal cultivation quite transparent, and turns it into a permanent cultivation.

If the cultivation is to be stained, it is previously treated with a watery spirituous solution of some basic anilin dye; it is next washed with weak spirit, and then the glass vessel is filled up with salt solution or acetate of potash.

The cultivation is cleared up and fixed by treating it with alcohol and then with petroleum, to which a few drops of nitro-benzol have been added to prevent fluorescence.

While the natural growth of fungi is better observed in minimal cultivations, stained preparations are more conveniently obtained from slide cultivations, and very minute details are given by the author as to the manner in which he proceeds. The great difficulty appears to be to get rid of the nutrient medium, as this absorbs anilin pigments more easily than the fungi to be stained. However, by treating the cultivation with a 20–30 per cent. potash solution and warming moderately the medium is so softened that it may be squeezed away from the

* Centralbl. f. Bakteriol. u. Parasitenk., x'. (1892) pp. 4–9, 40–44.

cultivation by means of a strip of oiled paper laid over the cultivation, the latter lying on the slide.

Preparations suitable for photographing are made as follows. A piece of agar cultivation is imbedded in celloidin and sectioned. The sections are then laid for about a minute in 5 per cent. caustic potash solution and after having been washed in water are immersed for five minutes or more in 5 per cent. acetic acid. The sections are then dried and stained for some seconds over the flame in phenol-fuchsin. They are again washed with water, and then partially dried with tissue paper. The sections are then dehydrated with anilin oil, and the latter having been removed with xylol the preparation is mounted in balsam.

By treating the fuchsin-stained sections for some seconds with a 1-5 per cent. solution of chromic acid or bichromate of potash, the contour of the fungi is said to be brought out more clearly, and the original colour to be darkened.

(3) Cutting, including Imbedding and Microtomes.

Notes on Celloidin Technique.*—Mr. A. C. Eyclesheimer writes as follows:—“The high value of celloidin as an imbedding mass is well known,† and its superiority over all methods requiring heat is unquestionable, yet, from the fact that its manipulation has been attended by many difficulties, it has not come into general use. During the past two years I have tried the methods recommended by various authors and have found none entirely satisfactory, especially where very long series were necessary. The results of my experience are embodied in the following method; the prepared plates or fragments are placed in an air-tight chamber; a 4 oz. salt mouth bottle being very suitable for this purpose. Pour into this bottle just enough ether-alcohol (equal parts acid, free sulphuric ether, and absolute alcohol) to cover the fragments. The ether-alcohol should be added until after occasional shaking no celloidin remains undissolved; this may take several days. It should finally possess the consistency of a very thick oil. The solution thus obtained may be labelled No. 4. No. 3 is obtained by taking two volumes of No. 4 and diluting with one volume of ether-alcohol. No. 2 by proceeding in a like manner with No. 3. No. 1 is a mixture of absolute alcohol and sulphuric ether in equal parts.

The saturation and final imbedding is accomplished thus: the object is transferred from 95 per cent. alcohol to solutions 1, 2, 3, 4, successively, in each of which it remains from a few hours to days, depending upon the size and permeability. For pieces of tissue 2 mm. in diameter twenty-four hours in each will generally suffice. For a large brain, e. g. that of a cat, a week in each will not be too long.

In imbedding, unless orientation is desired, the ordinary paper box is best. A thin plate of lead is placed in the bottom and the imbedding solution poured in. The object is taken from the same solution, and with needles wet in ether placed in the desired position. Fine needles may be passed through the box to support the object.

In hardening, the method given by Viallanes of immersing in chloroform is preferable, since the operations may be carried on with much

* Amer. Nat., xxvi. (1892) pp. 354-7.

† See *ante*, p. 438.

greater rapidity. An air-tight chamber should be filled with chloroform; a very wide-mouthed bottle will answer. After the mass is thoroughly hardened, which requires about twenty-four hours, it is removed, the paper cut from the sides, and transferred to 70 per cent. alcohol for a few hours.

It is now ready to fix for sectioning. Blocks are trimmed to fit the clamp of the microtome. Solution No. 3 is poured over the block; into this the celloidin block is pressed, after dipping the under surface in solution No. 1. Place in chloroform until hardened.

Reconstruction points are often very desirable. For this purpose the ordinary metallic imbedding box made of two L-shaped pieces, held in place by overlapping strips, is used. The ends and sides are perforated in as many places as desired by a very small drill. The holes should be so drilled that the silk threads which are drawn through run parallel.

After being drawn tightly they are cemented to the sides of the box by a drop of celloidin. Five or six cm. of the thread should be left hanging. The bottom of the box is made by fitting in a piece of heavy blotting-paper. The object is placed upon the threads in the desired position, and the imbedding mass poured in. As soon as hardened, the celloidin holding the threads is dissolved by a drop of ether. The loose ends are soaked in solution No. 2, which has been thickened by the addition of lampblack. The threads are then drawn through, leaving the lampblack adhering to the celloidin, thereby forming excellent reconstruction points.

For small objects, where reconstruction points are not needed, the following method may be advantageously employed. The heads are clipped from fine insect pins, which are then placed in handles in such a way that they may be easily removed. On these pins the objects are oriented in the desired position; the pins are then removed from the handles and fixed in a cork previously perforated by a somewhat larger pin. As fast as the pins carrying the object are inserted, the cork is replaced in the tube, which is filled with alcohol. A half-dozen fish or amphibian ova may be oriented on the same cork. If desirable to draw the objects *in situ* a piece of lead may be pinned to the cork, and the whole immersed in a small beaker of alcohol. The corks carrying the oriented objects are transferred successively to tubes containing the different solutions. When ready for final imbedding, a piece of porous paper is wrapped about the tubes and cork, and pinned. The cork is now removed, allowing the imbedding solution to fill the paper tube thus formed. A lead is fastened to the cork, and the whole placed in chloroform until hardened, after which the paper is cut from the mass and the pins drawn through the cork, when it is ready for sectioning. This method offers many advantages, in that several objects may be cut at the same time, drawings may be made after orientation, the objects are transferred from one solution to another more rapidly, &c.

In cutting, care should be taken that the knife is placed as obliquely as possible and kept constantly wet with 70 per cent. alcohol. For this purpose an ordinary pipette provided with a large rubber bulb is used. As fast as cut the sections are drawn back on

the blade of the knife by means of a needle, and arranged in a single row until the blade is filled. To remove them a heavy paper spatula is placed directly upon the section to which it adheres, and may be drawn off the edge of the knife and transferred to the slide. By slight pressure, together with a rolling movement, the section is left in the desired position. Sufficient alcohol is kept on the slide to prevent drying, but not enough to allow the sections to float. When the requisite number have been arranged, they are covered with a strip of toilet paper which is held on the slide by winding it with fine thread. The sections being thus firmly held in position may be stained, &c. They should not be placed in absolute alcohol, but cleared from 95 per cent. in a mixture of equal parts of bergamot oil, cedar oil, and carbolic acid. When cleared the excess of fluid is removed by a piece of blotting-paper with gentle pressure, sections which are by chance loose are firmly fixed in position, the thread is now cut, the strip of paper rolled back, balsam and cover applied. If the object can be stained *in toto*, which is often the case, much time may be saved by the following method: The stained object is imbedded in the usual manner, but after hardening in chloroform, and removing the paper, the celloidin block is transferred to 95 per cent. alcohol for twenty-four hours, then to carbolic acid* or glycerin in which it becomes as transparent as glass.† The block is fixed in the usual manner.

Orientation is now accomplished with the greatest ease. In cutting, the knife is wet with the clearing medium given above. The sections may be arranged in serial order on the knife-blade until a slideful is obtained, when they are transferred, balsam and cover applied. By this method long series may be readily handled. Glycerin is used only when the mounting medium is glycerin. In this case the knife is wet with glycerin."

Taylor's Freezing Microtome.‡—Dr. T. Taylor remarks:—"This combination microtome is adapted to three methods of section-cutting.

The instrument is of metal screwed to a block of polished mahogany. There is a revolving table with graduated margin, in the centre of which is fitted a freezing-box having two projecting tubes, one to admit freezing water, the other an outlet for it. The water is supplied from the reservoir and carried off by means of rubber tubing which is attached to the metal tubes, the terminal end of the outlet tube being furnished with a small glass tube, by means of which a too rapid outflow of water is prevented. The tubes of the freezing-box are so arranged as to prevent their revolving with the revolutions of the table. When ether is used, the little brass plug in front of the freezing-box is removed and the rubber tubing detached.

In preparing to make sections, remove the freezing-box, and in its place substitute a cork which projects suitably, holding the object from which sections are to be taken, imbedded in wax or paraffin, at the

* Bumpus (Am. Nat., Jan. 1892) advises the use of thymol.

† Since discovering this method of rendering celloidin blocks transparent, which was published in the Bot. Gaz., 1890, I have found that the clearing mixture given above answers the same purpose as the carbolic acid, but requires a little longer time.

‡ Amer. Mon. Micr. Journ., xiii. (1892) pp. 25-6.

required angle to the blade of the knife. The cork is raised or lowered by means of a finely cut screw-thread.

The curved knife is about 5 in. in length and 1 in. in breadth, ground flat on the under side, and held in position by a binding-screw, after the fashion of several microtomes previously in use. A straight knife may be used if desired."

(4) Staining and Injecting.

Double-staining of Sporigenous Bacilli.*—Sig. L. Macchiati describes the mechanical details of a process which he has found useful for the double staining of bacilli containing spores. The following are its more important points. The microbes are picked out by a sterilized platinum needle, and placed in a drop of sterilized distilled water which is evaporated in a platinum dish over an alcohol flame. When quite dry a staining solution is added composed of 5 gm. carbolic acid, 20 gm. alcohol, and 0·8 gm. fuchsin, made up to 100 gm. with water. When this is boiled and evaporated, the spores take up a rose-coloured stain which is very persistent, while the colour can be entirely removed from the bacillus itself by absolute alcohol. The bacilli can then be stained in the ordinary way by gentian-violet or methylen-blue.

Carbol-methylen-blue Method.†—Herr F. Pregl advises the following modification of Kühne's methylen-blue method ‡ as it is shorter and less decolorizing than the original procedure. The sections stuck on slide or cover-glass are stained for 1/2 to 1 minute with carbol-methylen-blue, with or without aid of heat. They are then washed for a short while with distilled water. Next they are immersed in 50 per cent. alcohol until they become pale blue with a somewhat greenish tinge, after this they are dehydrated in absolute alcohol, cleared up in xylol, and imbedded in balsam.

Spore-staining.§—Herr Foth says that the method suggested by H. Möller for staining spores is excellent. The process is as follows:—
1. Fixation by heat or absolute alcohol (2 minutes). 2. Removing fat, &c., in chloroform, 2 minutes. 3. 1/2–2 minutes' action of 5 per cent. chromic acid. 4. Staining with phenol-fuchsin over the flame for 60 seconds, once boiling. 5. Decolorizing in 5 per cent. H₂SO₄. 6. Contrast staining in saturated aqueous solution of malachite-green or methylen-blue, 30 seconds. By this method the spores are stained red and the bacilli blue.

Instead of chromic acid, chlorine water, eau de Javelle, or peroxide of hydrogen may be used; indeed, for many spores chromic acid is too strong, and is replaced by peroxide of hydrogen with advantage. Sometimes it is better to use anilin instead of carbolic acid with the fuchsin. Fixation by means of Loeffler's device, i.e. holding the cover-glass between thumb and finger over the flame, is just as safe and more advantageous than immersing the cover-glass in chloroform, though the latter procedure has its advantages.

* Malpighia, v. (1892) pp. 431–3.

† Centralbl. f. Bakteriöl. u. Parasitenk., x. (1892) pp. 826–9.

‡ See this Journal, 1890, p. 254.

§ Centralbl. f. Bakteriöl. u. Parasitenk., xi. (1892) pp. 272–8.

Besides the mere staining of the spores the author had in view the object of ascertaining if the resistance of spores could be measured by means of staining. Numerous experiments were made with tetanus, anthrax, symptomatic anthrax, and other bacteria, but the results, as far as the end in view was concerned, were not successful.

Staining Micro-organisms of the Cuticle.*—In preparing any portion of the outer skin (or its pathological derivatives), epidermis, hair, nails, scabs, &c., Dr. Unna first treats the specimen with a drop of acetic acid, then squeezing and flattening it out between two slides. This done, the slides are drawn apart and dried quickly in a flame; the fatty matters are next removed by running a few drops of ether-alcohol over them while held obliquely.

Then upon one slide are placed two drops of borax-methylen-blue (borax 1, methylen-blue 1, H₂O 100) and this is covered with the other slide, and the two heated in the flame for 10-20 seconds. After this, the preparations are further decolorized or dried in the flame.

The author treats preparations deprived of fat and dried in the air with a drop of borax-methylen-blue solution, and a drop of glycerin; puts on a cover-glass, and warms gently for five minutes. The preparation is then washed with water, dried in the flame, and inbedded in balsam.

The results were even better when glycol or glycerin-ether were used instead of glycerin.

As attenuants of the staining solution and as decolorants of the tissue stained, the author used a large number of substances, but found that the best decolorizing results were obtained when physical and chemical extractives were used in combination, e. g. permanganate of potash and peroxide of hydrogen.

NASTUKOW, M. M., & M. J. PEWSNER—*Ueber Sublimat-Anilin-Farbstoffe in der Bakteriologie.* (On Sublimat-anilin-colouring Matters in Bacteriology.)

Wratsch, 1892, pp. 310-1 (Russian).

SABOURAUD, R.—*Quelques faits relatifs à la méthode de coloration de Lustgarten.* (Some points regarding Lustgarten's Staining Method.)

Ann. Inst. Pasteur, 1892, pp. 181-340.

UNNA, P. G.—*Die Färbung der Mikroorganismen im Horngeewebe.* (The Coloration of Micro-organisms in Horny Tissue.)

Hamburg, 1891, 8vo, 38 pp.

(5) Mounting, including Slides, Preservative Fluids, &c.

Shimer's new Mounting Medium.†—This is made of equal parts of Farrant's solution, glycerin, and glycerin-jelly, the last being made of gelatin, 30 parts; water, 70 parts; glycerin, 100 parts; carbolic acid, 2 parts. Of this jelly, liquefied by the aid of a water-bath, pour one fluid oz. into a 4-oz. glass stoppered bottle, add an equal volume of the Farrant's medium and of glycerin. Agitate, thoroughly mix, and add a small lump of camphor. A little warming is necessary to make it fluid for use.

The Short Slide as a Safety Slide.‡—Dr. Henry Shimer remarks:—“Much has been said in microscopical books, journals, and elsewhere,

* *Monatsschr. f. prakt. Dermat.*, xiii. (1891) pp. 225 and 286. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xi. (1892) pp. 315-7.

† ‘Pacific Record,’ see *Amer. Mon. Micr. Journ.*, xiii. (1892) p. 110.

‡ *Microscope*, xi. (1891) pp. 266-70.

about care in using high power objectives, and warning of the danger of racking downward, &c. Having to use a fine, high power, dry objective of very short working distance, always nearly or quite touching the cover-glass when in focus, it is well known that the thickness of a series of cover-glasses of the same number varies greatly; hence, one of a package could be worked through, while another could not.

Looking across the stage and carefully racking down until the front of the lens was so close to the cover that I could not see between them with a hand-lens, thereupon applying the eye to the eye-piece, and manipulating the screw of the fine-adjustment, I often found that I was still above the focus, and it became an important consideration as to how close I could press the cover-glass with safety and advantage when searching for an object mounted in aqueous or glycerin medium. The little accidental notes when seen moving about in the medium sounded a note of alarm and said, 'You can go no closer; even now there is danger.' I have a so-called safety nose-piece in my possession, a contrivance with a spring in it between the tube and the objective, to prevent unbearable pressure, but it is not always on the stand; moreover, it is a troublesome thing in changing objectives where the stand has a short working distance, for it makes quite a long affair to handle and not touch the cover-glass in changing lenses after using a low power as a finder. This safety spring admitted of an unpleasant pressure, sometimes causing the mounting fluid to swell over the cover-glass, sometimes getting on to the lens, greatly to my annoyance. At this junction I looked about me for a better remedy than the safety nose-piece to use in my studies of objects on slides not finished by drying and sealing in a permanent mount. I then began to use the short slide as presently to be described. It was a new idea to me; whether new or not to other and more experienced workers, I cannot tell, but I do not remember having ever seen it mentioned in any of the microscopical books or journals at my command. I formed, in this way, a preference for slides 2 in. long and $7/8$ in. wide, finally coming down to 1 in. and $3/4$ in. long, and corresponding in length with the excellent short slides furnished by the Bausch & Lomb Optical Company, and very nearly corresponding with the length of the German slides furnished by Zeiss, of Jena, and to be had of Emmerick, in New York. Both of these, however, I found too wide for using as safety slides with my apparatus, the opening in the slide carrier on my No. 560 Bausch and Lomb stand being just an inch wide. I therefore was obliged to get the best, clearest glass I could find, and make my own slides, $7/8$ and $3/4$ in. wide by 1 and $3/4$ in. long. A fine file or a piece of scythe whetstone rubbed over the edges and corners removes any sharpness, and is quickly done. A thousand slides of this kind can be easily and quickly made, and will answer every purpose in ordinary work. By mounting the object in one end I have a safety slide.

Place the slide so that the mounted end, when projecting over the opening in the stage, is free in air. Now it is apparent that when thus placed under the close-working objective it cannot be injured, because, when the point of the objective presses on the cover-glass ever so slightly, it can make no more than this slight pressure, for the slide, being placed sec-saw-like over the opening, will begin the dip of the sec-

saw motion, and tell me that closer racking is useless. In this way I avoid the great care that is necessary in using the old 3-in. or long slide with the mount in the middle. This is without the least possible danger of injury to either the mount or the objective, while that is not. This is my first plea for the short slide. Such safety can hardly be furnished by any other device, and certainly no other is so free from annoying care. (2) The short slide is more conveniently stored in a horizontal till, which is preferable to sliding in the sawed grooves, and just as easily handled by the free end when we are accustomed to it. (3) The short slide is less likely to be broken if it accidentally falls on a hard floor, the liability to break increasing as the square of the length, or more rapidly. A slide an inch long would hardly break once in a thousand falls, while one a foot long would most surely break at the first. (4) The short slide is lighter and more conveniently packed for transportation, which is important especially in the mails. (5) The short slide costs less, an item of some importance to many of us.

There are some objections to the short slide. The principal ones are as follows:—(1) It is not the standard slide. It is not the fashion, and to be out of fashion is a great load for many to bear. (2) The long slide may be better adapted to work on the turntable, which is a great convenience where a cell is to be made; still the circular cell can be made on the end of the slide with a suitable turntable. A square cell can readily and more quickly be made by hand, and a square cover can be cemented around the border more quickly than the slide can be placed on the turntable, and the square cover is better for most purposes, except for glycerin mounting, now nearly out of credit, and perhaps for dry mounting. (3) The long slide has some claims of moment in manipulating on the stage, in case we have no slide-carrier; but why be without a slide-carrier? If I had none I would at once improvise one with a thin piece of cigar-box lid, pasteboard, tin, or a long piece of glass, five or six inches long, the former, of course, with a hole cut in the middle. I have tried Microscopes formerly without slide-carriers, but after using one for fifteen years with a slide-carrier, I would almost as soon think of being without a Microscope as to be without this first and greatest convenience in manipulating the slide on the stage. If the opening in my slide-carrier were $1\frac{1}{8}$ in. wide, as it ought to be, I would probably use all slides $1\frac{3}{4}$ in. by 1 in., such as those sold by the Bausch & Lomb Optical Company, but, as it is, I have been obliged for some time past to work against another prejudice and use narrower slides, and I find a slide $\frac{3}{4}$ or $\frac{7}{8}$ in. wide ample for most uses, and for all covers $\frac{3}{8}$ to $\frac{3}{4}$ in. square, and is sufficient for the label; so what more do we want? If it is more labelling room, the two sides of the free end of the short slide can be used, thus affording plenty of space for the purpose.

The labels which I prefer for the purpose I cut out of gummed paper in slips $\frac{1}{4}$ to $\frac{1}{2}$ in. wide, and 2 to $2\frac{1}{4}$ in. long as needed. Moisten and apply round the free end of the slide; after drying, write the name and number on the upper surface, and the mounting medium, date, and stain on the lower. In this way I find room for everything on the short slide.

I have heard it objected that the label under the slide places the latter out of level on the stage. This, at first sight, appears true, at

least theoretically. But let us see how fine a theory it is. The thickness of a sheet of my gummed paper, measured by a micrometer, is about $1/1000$ in., determined by holding the paper edgewise in a stage-forceps under the Microscope. In case we are using a power of 500 diameters, the field will be about $1/100$ in. across. Now, by proportion, the length of the slide is to the diameter of the field as the thickness of the label is to the inclination of the field, or x . Then $1\frac{3}{4}$ in., $1/100$ in., $1/1000$ in. x , $7/4 x = 1/100,000$, $x = 1/175,000$ in., for the variation from a theoretical true level, or in the breadth of vision with a $1/5$ or $1/6$ objective; and if we are using a 2-in., $1/10$ of that, which is $1/17,500$, is out of level, on account of the level on the under side of one end.

Where is the instrument maker, however skilful, who can construct a stand the tubes of which shall vary so little as that from a true perpendicular to the stage? The best slides may vary more than that in the thickness of ends. Stands that raise one side of the stage by the fine-adjustment, as do some of the Acme stands of J. W. Queen & Co., disregard this principle in a very much larger degree without detriment. This is my plea for the short slide. Will the reader allow me to submit it for its worth, without expecting to see its general adoption, but hoping to help some one who, like myself, is often bothered about the close working objectives, that in spite of all carefulness, occasionally impinge upon the cover-glass? Racking downwards is very troublesome to old eyes using high powers. They find it difficult to look across the stage to reach below the focus, where the looking distance is $1/100$ in. or less. Let all such try my safety slide, and they will find its perfect working convenience an ample compensation for being out of fashion or for lack of imaginary beauty, and after using it often and long, and trying it faithfully and well, they will, like myself, never wish to see another long slide for ordinary microscopical work."

(6) Miscellaneous.

Squire's "Methods and Formulæ" used in Microscopical Examination.*—The usefulness of this compilation will be obvious to any histologist, as it contains formulæ and advice for microscopical work in all branches of the subject save that of section-cutting. Great numbers of the formulæ are certainly correct, and the advantage of having these in a small and compendious volume will, no doubt, be evident to a great number of workers. For a first attempt the work is very excellent, but the formulæ for bacteria staining will require revision and amplification for a second edition. For example, no mention is made of the best and most rapid method of staining tubercle bacilli, the Neelsen-Glorieux, nor the most elegant and satisfactory, that of Czaplewski. It is satisfactory to note that no allusion is made to methyl-blue, a pigment which might easily be dispensed with, while with regard to methylen-blue, we would suggest the addition of a formula with an acidity corresponding to the alkalinity of Loeffler's methylen-blue.

Microscopical Examination of Potable Water.†—Mr. G. W. Rafter has just brought out a neat and practical little volume which deals with

* 'Methods and Formulæ,' J. and A. Churchill, 1892, 93 pp.

† Van Nostrand's Science Series, New York, 1892, 18mo, 160 pp.

the microscopical examination of potable water. The author's aim is to make the biological method a check on the chemical analysis, for it is only by an accurate investigation of the number and character of living organisms that the exact value of free and albuminoid ammonia can be estimated. The present monograph only deals with non-bacterial organisms, and is divided into two parts, the first of which treats of methods, apparatus, &c., required for making a qualitative examination of a water supply. In the second part the subject is treated quantitatively, the author showing how the organisms may be counted, and the inferences to be derived from their specific characters though "the sanitary significance and relative economic importance of the microscopical forms will be treated in another volume."

Filtration of Water through Stone Filters.*—Prof. E. von Esmarch finds that the ordinary stone filters are, like charcoal filters, quite useless for sanitary purposes since they are only capable of removing the coarser impurities from turbid water. In one respect, indeed, they make matters worse, since they actually aid in propagating the poison they are presumed to remove from the tainted water. The filters experimented with came from various parts, their filtering bed being composed of lava, tufa, or of sandstone. Naturally the great point to be ascertained was whether these filters would remove bacteria, and this was done by passing through Berlin water to which some pigment-forming bacteria had been previously added. It was found that the germs not only passed through, but after a certain lapse of time actually increased. It was obvious, therefore, that this increase must take place in the pores of the filter, a result which does not seem at all surprising since filters are not prone to possess a germicidal action, and it must be pointed out that the conditions of the experiment were unusually favourable for the development of microbes and quite different from those under which water is usually filtered. For example, a considerable quantity of organic matter, i. e. of the cultivation medium, must have been mixed with the water. All the same the experiments are worthy of record, as the use of filters no doubt leads to undue confidence in their virtue.

The Microscopic Structure of some Australian Rocks.†—The Rev. J. Milne Curran, in the concluding part of his paper, says:—"A microscopic examination of our rocks points to the existence in Eastern Australia of every leading type from the vitreous to the holo-crystalline condition, both acidic and basic, and their general microscopic structure conforms to well-known types of described American and European rocks. In writing of American basalts, Zirkel says,‡ 'It is worth while to pause, and remark that in these widely remote quarters of the globe, the product of the solidification of a molten mass, although exposed to many casualties, has, nevertheless, maintained a surprisingly close identity of microscopical composition.' The remark applies in every particular to the Australian basalts described in this paper.

Within well-defined limits, the structure of our basalts shows micro-

* *Centralbl. f. Bakteriöl. u. Parasitenk.*, xi. (1892) pp. 525-31.

† *Journ. and Proc. Roy. Soc. N.S. Wales*, xxv. (1891) pp. 179-233, pls. xx.-xxii.

‡ *U.S. Geol. Explor. Fortieth Parallel*, vol. vi. *Microscopical Petrography*, p. 253.

scopical peculiarities that enable us to recognize certain types of structure as characteristic of particular districts, for instance, a micro-slice of basalt from Orange can always be distinguished from similar rocks at Bathurst.

In regard to the order of solidification of minerals, as a rule nothing exceptional is to be noted in the material examined. The cavities of some basalts are filled, as at Carcoar, with aragonite. There is nothing in the microscopic character of the slices to show that the lime for this mineral was derived from the surrounding rock. On the contrary, there are Tertiary volcanic rocks at Rocky Bridge Creek with their cavities filled by opal and hyalite, and the Microscope shows that this material has been derived from the silicates of the rock itself.

As far as it is yet known the great bulk of the eruptive rocks of New South Wales are basic in composition. Intermediate rocks are not common. Acidic rocks are rare. There are extensive metalliferous deposits about Cobar, but the Microscope reveals no intrusive rocks in connection with these deposits.

Many of our granites are suffering from a decay called by Dolomieu 'la maladie du granit.'^{*} Carbonic acid gas in the air, as has been suggested, may have a good deal to do with this process of disintegration, but the Microscope shows that to a certain extent the disease is internal. The quartz of some granites is seen to contain numerous gas cavities, and the cloudiness and incipient kaolinization of the feldspars is probably due to the absorption of the free gas they once held.

Many of the rocks called diorites are augitic rather than hornblendic, and therefore must be classed with diabase. In the conversion of a clay-slate to a hornfels, as at Bathurst, the Microscope shows that the alteration of the rock consists in a rearrangement of the old minerals, and the introduction of one new one, namely mica. This corresponds with observations made on similar rocks in other parts of the world. The wide distribution of Tertiary leucite rocks in New South Wales is a matter of considerable interest.

The specimens with which this paper deals have been collected over widely separated localities. There is material enough in any one district for considerable petrological research, but it has been my purpose rather to indicate the wealth and variety of our material for work, than to give exhaustive details of any one field. Much of the matter furnished will, I trust, prove new and of some interest to Australian geologists."

* Lyell's 'Principles of Geology,' 11th edition, vol. i. p. 409.

PROCEEDINGS OF THE SOCIETY.

MEETING OF 15TH JUNE, 1892, AT 20, HANOVER SQUARE, W.,
THE PRESIDENT (DR. R. BRAITHWAITE, F.L.S.) IN THE CHAIR.

The Minutes of the meeting of 18th May last were read and confirmed, and were signed by the President.

The List of Donations (exclusive of exchanges and reprints), received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Braithwaite, R., British Moss Flora. Pt. xiv. (4to, London, 1892)	The Author.
Six Slides of Hydroid Zoophytes	Mr. E. Hinton.
Zimmermann, A., Botanische Mikrotechnik. (8vo, Tübingen, 1892)	The Author.

Dr. W. H. Dallinger called special attention to six slides of Hydroid Zoophytes presented to the Society by Mr. Hinton, which were upon the table for exhibition; he also mentioned that they had received an advance copy of Part xiv. of the 'British Moss Flora' from their President.

The President said it was probably known to all present that on the morning of the day of their last meeting their old friend Mr. W. W. Reeves departed this life, the news reaching them on the following day. He had been ill for six or seven months, and had gone down into Yorkshire to stay with his sister at whose house he died, and to whom it was proposed to send a letter of condolence from the Society. The President remarked that he had known Mr. Reeves personally for over thirty years, and had valued his friendship and his ready willingness to place his botanical knowledge at the disposal of any one who required his assistance. Mr. Reeves was almost the founder of the Quekett Club Excursions, from which, whilst in health, he was rarely absent. He was also most regular in his attendance at the meetings of the Society and had been a member of its council for a number of years; they would regard his loss with very great regret. It was a fancy with some people to poke fun at him, but those who knew him intimately knew him to be one of the gentlest and kindest creatures they ever met with.

The President said they were unfortunately in the position of being without a paper for the meeting that evening; he hoped, therefore, that if any Fellow had any subject of interest which he could bring forward for discussion, he would do so.

Dr. Dallinger said that their Scientific Societies appeared to afford instances of the reversal of the activities of nature, for whereas in nature all around them they saw as the summer-time approached everything in the vegetable and animal world filled with renewed vigour, in a Society such as theirs it seemed as if their energies became impaired;

at any rate it was always very difficult to get papers at that period of the year, and that was not the first time it had happened there was no paper forthcoming at their meeting in June.

Mr. R. T. Lewis said it might be interesting to mention that a further opportunity had been afforded him of confirming the observation described in his paper "On the process of Oviposition in a Cattle Tick" (see *ante*, p. 449) at the last meeting of the Society. About a week after that meeting he received another small packet from Natal amongst the contents of which were several living ticks obviously different in species from the one which he had previously described. One of these he had kept under observation since its arrival, and had seen it lay a large number of eggs during the interval. In principle the process was found to be precisely the same as in the former case, although a difference in species and size had modified the shape of some of the parts concerned. The depression formed by the retraction of the rostrum was somewhat smaller in proportion and more nearly triangular in shape; the diaphanous body was evolved from the cavity above the rostrum in much the same manner as before described, but when fully expanded did not in this instance develop two terminal papillæ with an open receptacle between them, but appeared rather to end in two very mobile hemispherical caps, the edges of which overlapped and moved freely over each other, and in this way kept the mucous chamber inclosed. The ovipositor was extended in the same way as formerly observed, but on reaching the hemispheres buried itself between them; whilst in this position the egg was laid; so that although its passage through the ovipositor was quite obvious, it was itself concealed from view and in most cases was not seen until ultimately exposed by the withdrawal of the mucous receptacles. Its subsequent removal by the palpi took place in the same manner as noted in the original observation. Possibly owing to the exhausted condition of the specimen, the process took place at a much slower rate than in the former instance.

Coloured drawings in illustration of these remarks were handed to the President for inspection.

Mr. A. D. Michael said he had received two specimens of these ticks from Mr. Lewis, but unfortunately although they appeared to have been most carefully packed they were quite dead on arrival, whether from any treatment in the post, or from having laid all their eggs and so become exhausted he was unable to say.

Mr. Lewis regretted to hear that these ticks had died in transit; he was unable to account for it, having selected from four specimens the two which appeared to be the most vigorous and active, in the hope that Mr. Michael would receive them in good condition and be able to repeat the observations. They had come to him by post from Natal packed loosely in sawdust with other things and without any regard to their comfort or survival; they had laid a large number of eggs during the voyage but seemed quite lively when unpacked; as a rule ticks did not prove at all easy to kill with rough treatment.

Mr. T. Curties said it would be interesting to know from Mr. Michael what he would recommend as the best method of packing living specimens so that they might be received here alive from long distances,

although they had just heard of some which came alive from South Africa and yet died during postage in England.

Mr. Michael said that the Acari would generally travel quite well under any conditions which provided against their becoming dried up, it being an absolute condition of life with them that they should be kept to a certain degree moist. If put into a tin box with a little damp moss they would often do well, or the more delicate kinds would come safely upon the fleshy bulb of a plant; he had received them quite in good condition in this way from Australia and New Zealand. They would also come over quite well alive on the bulbs of orchids, especially if a little moisture was also put into the box. With *Ixodes* it was not quite the same, they would not need such careful treatment.

Mr. T. Charters White said a common method of keeping tobacco damp was by putting a slice of raw potato with it, perhaps something of that kind would answer the purpose.

The President thought that many of the Acarina were so delicate that it would be necessary to pack them in something quite soft; he should suggest wet moss as being a suitable material.

Mr. G. C. Karop thought that potato had such a way of getting mouldy that it would be very objectionable and would be most likely to fill the box with mycelium long before it arrived.

Mr. Curties said his idea in asking the question was to get some suggestion conveyed by means of the Journal to correspondents abroad as to how they might best send home specimens for examination. If they knew what to do they might be induced to send things more frequently, which might prove very useful additions to their 'Proceedings,' when examined and described as in the case before them.

The President said he quite agreed with Mr. Curties, who he thought had done a good thing in bringing the matter forward; many subjects of great interest might arise from objects sent over by those who were residing abroad, and he hoped that their attention would be drawn to the utility of doing so by seeing the suggestion in the Journal.

Mr. E. M. Nelson said he wished to call attention to rather an important point connected with the credit of the Society as maintained by its Journal. Things were put into the Journal for two reasons, either because they were of scientific value or because they were matters for ridicule. Now in the number just issued there was an article headed "A New Construction for the Microscope" detailing something which Dr. A. Lendl had been discovering, as if it was something of wonderful value, although as a matter of fact it was a principle which had been condemned over and over again, and there was nothing new whatever about it. It was a plan for putting one Microscope over another and so examining the image formed by one objective by means of another objective and compound Microscope instead of with an ordinary eye-piece. He could only say that any conclusions as to structure formed upon what was seen by such an arrangement as that, would be utterly misleading and valueless—indeed they might just as well go out and buy a penny Microscope in the street and then say they had made a lot of wonderful discoveries with it. He protested against such

things being put seriously into the Journal to mislead people with the idea they were approved of by the Royal Microscopical Society.

Dr. Dallinger said that so far as the actual structure of this arrangement was concerned, no doubt Mr. Nelson was perfectly correct, but the fact of its having been described in the Journal did not necessarily imply that the Society approved of the apparatus.

The President called attention to the note at the foot of p. 342 of the same number of the Journal in which it was clearly stated that the Society "do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them," the same intimation appearing at the commencement of the "Summary" in every number issued. Mr. Nelson was quite right in pointing out the character of the apparatus described and due weight would no doubt be given to his remarks when they appeared in the next number of the Journal.*

The President reminded the Fellows that they had come to the end of their last meeting for the present season and would not reassemble until October 19th. He gave notice that the Society's rooms would be closed from August 15th to September 12th; also that the *Conversazione* had been arranged for November 30th.

The following Instruments, Objects, &c., were exhibited:—

Mr. E. Hinton :—Slides of Hydroid Zoophytes.

Mr. R. T. Lewis :—Diagrams of the organs of oviposition in a species of Cattle Tick.

Mr. C. Rousselet :—*Asplanchna Brightwellii*, mounted.

New Fellows :—The following were elected *Ordinary* Fellows :—
Dr. Douglas H. Anderson and Mr. T. Alfred W. Rees.

* See *ante*, p. 542.

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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

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Edinburgh,

FELLOWS OF THE SOCIETY.



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APERTURE TABLE.

Numerical Aperture. ($n \sin u = a$.)	Corresponding Angle ($2u$) for			Limit of Resolving Power, in Lines to an Inch.			Illuminating Power. (a^2)	Penetrating Power. ($\frac{1}{a}$)
	Air ($n = 1.00$.)	Water ($n = 1.33$.)	Homogeneous Immersion ($n = 1.52$.)	White Light. ($\lambda = 0.5269 \mu$, Line E.)	Monochromatic (Blue) Light. ($\lambda = 0.4861 \mu$, Line F.)	Photography. ($\lambda = 0.4000 \mu$, Near Line H.)		
1.52	..	..	180° 0'	146,543	158,845	193,037	2.310	.658
1.51	..	..	166° 51'	145,579	157,800	191,767	2.280	.662
1.50	..	..	161° 23'	144,615	156,755	190,497	2.250	.667
1.49	..	..	157° 12'	143,651	155,710	189,227	2.220	.671
1.48	..	..	153° 39'	142,687	154,665	187,957	2.190	.676
1.47	..	..	150° 32'	141,723	153,620	186,687	2.161	.680
1.46	..	..	147° 42'	140,759	152,575	185,417	2.132	.685
1.45	..	..	145° 6'	139,795	151,530	184,147	2.103	.690
1.44	..	..	142° 39'	138,830	150,485	182,877	2.074	.694
1.43	..	..	140° 22'	137,866	149,440	181,607	2.045	.694
1.42	..	..	138° 12'	136,902	148,395	180,337	2.016	.709
1.41	..	..	136° 8'	135,938	147,350	179,067	1.988	.709
1.40	..	..	134° 10'	134,974	146,305	177,797	1.960	.714
1.39	..	..	132° 16'	134,010	145,260	176,527	1.932	.719
1.38	..	..	130° 26'	133,046	144,215	175,257	1.904	.725
1.37	..	..	128° 40'	132,082	143,170	173,987	1.877	.729
1.36	..	..	126° 58'	131,118	142,125	172,717	1.850	.735
1.35	..	..	125° 18'	130,154	141,080	171,447	1.823	.741
1.34	..	..	123° 40'	129,189	140,035	170,177	1.796	.746
1.33	..	180° 0'	122° 6'	128,225	138,989	168,907	1.769	.752
1.32	..	165° 56'	120° 33'	127,261	137,944	167,637	1.742	.758
1.30	..	155° 38'	117° 35'	125,333	135,854	165,097	1.690	.769
1.28	..	148° 42'	114° 44'	123,405	133,764	162,557	1.638	.781
1.26	..	142° 39'	111° 59'	121,477	131,674	160,017	1.588	.794
1.24	..	137° 36'	109° 20'	119,548	129,584	157,477	1.538	.806
1.22	..	133° 4'	106° 45'	117,620	127,494	154,937	1.488	.820
1.20	..	128° 55'	104° 15'	115,692	125,404	152,397	1.440	.833
1.18	..	125° 3'	101° 50'	113,764	123,314	149,857	1.392	.847
1.16	..	121° 26'	99° 29'	111,835	121,224	147,317	1.346	.862
1.14	..	118° 0'	97° 11'	109,907	119,134	144,777	1.300	.877
1.12	..	114° 44'	94° 55'	107,979	117,044	142,237	1.254	.893
1.10	..	111° 36'	92° 48'	106,051	114,954	139,698	1.210	.909
1.08	..	108° 36'	90° 34'	104,123	112,864	137,158	1.166	.926
1.06	..	105° 42'	88° 27'	102,195	110,774	134,618	1.124	.943
1.04	..	102° 53'	86° 21'	100,266	108,684	132,078	1.082	.962
1.02	..	100° 10'	84° 18'	98,338	106,593	129,538	1.040	.980
1.00	180° 0'	97° 31'	82° 17'	96,410	104,503	126,998	1.000	1.000
0.98	157° 2'	94° 56'	80° 17'	94,482	102,413	124,458	.960	1.020
0.96	147° 29'	92° 24'	78° 20'	92,554	100,323	121,918	.922	1.042
0.94	140° 6'	89° 56'	76° 24'	90,625	98,223	119,378	.884	1.064
0.92	133° 51'	87° 32'	74° 30'	88,697	96,143	116,838	.846	1.087
0.90	128° 19'	85° 10'	72° 36'	86,769	94,053	114,298	.810	1.111
0.88	123° 17'	82° 51'	70° 44'	84,841	91,963	111,758	.774	1.136
0.86	118° 38'	80° 34'	68° 54'	82,913	89,873	109,218	.740	1.163
0.84	114° 17'	78° 20'	67° 6'	80,984	87,783	106,678	.706	1.190
0.82	110° 10'	76° 8'	65° 18'	79,056	85,693	104,138	.672	1.220
0.80	106° 16'	73° 58'	63° 31'	77,128	83,603	101,598	.640	1.250
0.78	102° 31'	71° 49'	61° 45'	75,200	81,513	99,058	.608	1.282
0.76	98° 56'	69° 42'	60° 0'	73,272	79,423	96,518	.578	1.316
0.74	95° 28'	67° 37'	58° 16'	71,343	77,333	93,979	.548	1.351
0.72	92° 6'	65° 32'	56° 32'	69,415	75,242	91,439	.518	1.389
0.70	88° 51'	63° 31'	54° 50'	67,487	73,152	88,899	.490	1.429
0.68	85° 41'	61° 30'	53° 9'	65,559	71,062	86,359	.462	1.471
0.66	82° 36'	59° 30'	51° 28'	63,631	68,972	83,819	.436	1.515
0.64	79° 36'	57° 31'	49° 48'	61,702	66,882	81,279	.410	1.562
0.62	76° 38'	55° 34'	48° 9'	59,774	64,792	78,739	.384	1.613
0.60	73° 44'	53° 38'	46° 30'	57,846	62,702	76,199	.360	1.667
0.58	70° 54'	51° 42'	44° 51'	55,918	60,612	73,659	.336	1.724
0.56	68° 6'	49° 48'	43° 14'	53,990	58,522	71,119	.314	1.786
0.54	65° 22'	47° 54'	41° 37'	52,061	56,432	68,579	.292	1.852
0.52	62° 40'	46° 2'	40° 0'	50,133	54,342	66,039	.270	1.923
0.50	60° 0'	44° 10'	38° 24'	48,205	52,252	63,499	.250	2.000
0.45	53° 30'	39° 33'	34° 27'	43,385	47,026	57,149	.203	2.222
0.40	47° 9'	35° 0'	30° 31'	38,564	41,801	50,799	.160	2.500
0.35	40° 58'	30° 30'	26° 38'	33,744	36,576	44,449	.123	2.857
0.30	34° 56'	26° 4'	22° 46'	28,923	31,351	38,099	.090	3.333
0.25	28° 58'	21° 40'	18° 56'	24,103	26,126	31,749	.063	4.000
0.20	23° 4'	17° 18'	15° 7'	19,282	20,901	25,400	.040	5.000
0.15	17° 14'	12° 58'	11° 19'	14,462	15,676	19,050	.023	6.667
0.10	11° 29'	8° 38'	7° 34'	9,641	10,450	12,700	.010	10.000
0.05	5° 44'	4° 18'	3° 46'	4,821	5,252	6,350	.003	20.000

COMPARISON OF THE FAHRENHEIT AND CENTIGRADE THERMOMETERS.

Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.
212	100	158	70	104	40	50	10	- 4	- 20
210·2	99	156·2	69	102·2	39	48·2	9	- 5·8	- 21
210	98·89	156	68·89	102	38·89	48	8·89	- 6	- 21·11
208·4	98	154·4	68	100·4	38	46·4	8	- 7·6	- 22
208	97·78	154	67·78	100	37·78	46	7·78	- 8	- 22·22
206·6	97	152·6	67	98·6	37	44·6	7	- 9·4	- 23
206	96·67	152	66·67	98	36·67	44	6·67	- 10	- 23·33
204·8	96	150·8	66	96·8	36	42·8	6	- 11·2	- 24
204	95·56	150	65·56	96	35·56	42	5·56	- 12	- 24·44
203	95	149	65	95	35	41	5	- 13	- 25
202	94·44	148	64·44	94	34·44	40	4·44	- 14	- 25·56
201·2	94	147·2	64	93·2	34	39·2	4	- 14·8	- 26
200	93·33	146	63·33	92	33·33	38	3·33	- 16	- 26·67
199·4	93	145·4	63	91·4	33	37·4	3	- 16·6	- 27
198	92·22	144	62·22	90	32·22	36	2·22	- 18	- 27·78
197·6	92	143·6	62	89·6	32	35·6	2	- 18·4	- 28
196	91·11	142	61·11	88	31·11	34	1·11	- 20	- 28·89
195·8	91	141·8	61	87·8	31	33·8	1	- 20·2	- 29
194	90	140	60	86	30	32	0	- 22	- 30
192·2	89	138·2	59	84·2	29	30·2	- 1	- 23·8	- 31
192	88·89	138	58·89	84	28·89	30	- 1·11	- 24	- 31·11
190·4	88	136·4	58	82·4	28	28·4	- 2	- 25·6	- 32
190	87·78	136	57·78	82	27·78	28	- 2·22	- 26	- 32·22
188·6	87	134·6	57	80·6	27	26·6	- 3	- 27·4	- 33
188	86·67	134	56·67	80	26·67	26	- 3·33	- 28	- 33·33
186·8	86	132·8	56	78·8	26	24·8	- 4	- 29·2	- 34
186	85·56	132	55·56	78	25·56	24	- 4·44	- 30	- 34·44
185	85	131	55	77	25	23	- 5	- 31	- 35
184	84·44	130	54·44	76	24·44	22	- 5·56	- 32	- 35·56
183·2	84	129·2	54	75·2	24	21·2	- 6	- 32·8	- 36
182	83·33	128	53·33	74	23·33	20	- 6·67	- 34	- 36·67
181·4	83	127·4	53	73·4	23	19·4	- 7	- 34·6	- 37
180	82·22	126	52·22	72	22·22	18	- 7·78	- 36	- 37·78
179·6	82	125·6	52	71·6	22	17·6	- 8	- 36·4	- 38
178	81·11	124	51·11	70	21·11	16	- 8·89	- 38	- 38·89
177·8	81	123·8	51	69·8	21	15·8	- 9	- 38·2	- 39
176	80	122	50	68·2	20	14	- 10	- 40	- 40
174·2	79	120·2	49	66	19	12·2	- 11	- 41·80	- 41
174	78·89	120	48·89	66·4	18·89	12	- 11·11	- 42	- 41·11
172·4	78	118·4	48	64	18	10·4	- 12	- 43·60	- 42
172	77·78	118	47·78	64·6	17·78	10	- 12·22	- 44	- 42·22
170·6	77	116·6	47	62	17	8·6	- 13	- 45·40	- 43
170	76·67	116	46·67	62·8	16·67	8	- 13·33	- 46	- 43·33
168·8	76	114·8	46	60	16	6·8	- 14	- 47·20	- 44
168	75·56	114	45·56	60	15·56	6	- 14·44	- 48	- 44·44
167	75	113	45	59	15	5	- 15	- 49	- 45
166	74·44	112	44·44	58	14·44	4	- 15·56	- 50	- 45·56
165·2	74	111·2	44	57·2	14	3·2	- 16	- 50·80	- 46
164	73·33	110	43·33	56	13·33	2	- 16·67	- 52	- 46·67
163·4	73	109·4	43	55·4	13	1·4	- 17	- 52·60	- 47
162	72·22	108	42·22	54	12·22	0	- 17·78	- 54	- 47·78
161·6	72	107·6	42	53·6	12	- 0·4	- 18	- 54·40	- 48
160	71·11	106	41·11	52	11·11	- 2	- 18·89	- 56	- 48·89
159·8	71	105·8	41	51·8	11	- 2·2	- 19	- 56·20	- 49
								- 58	- 50

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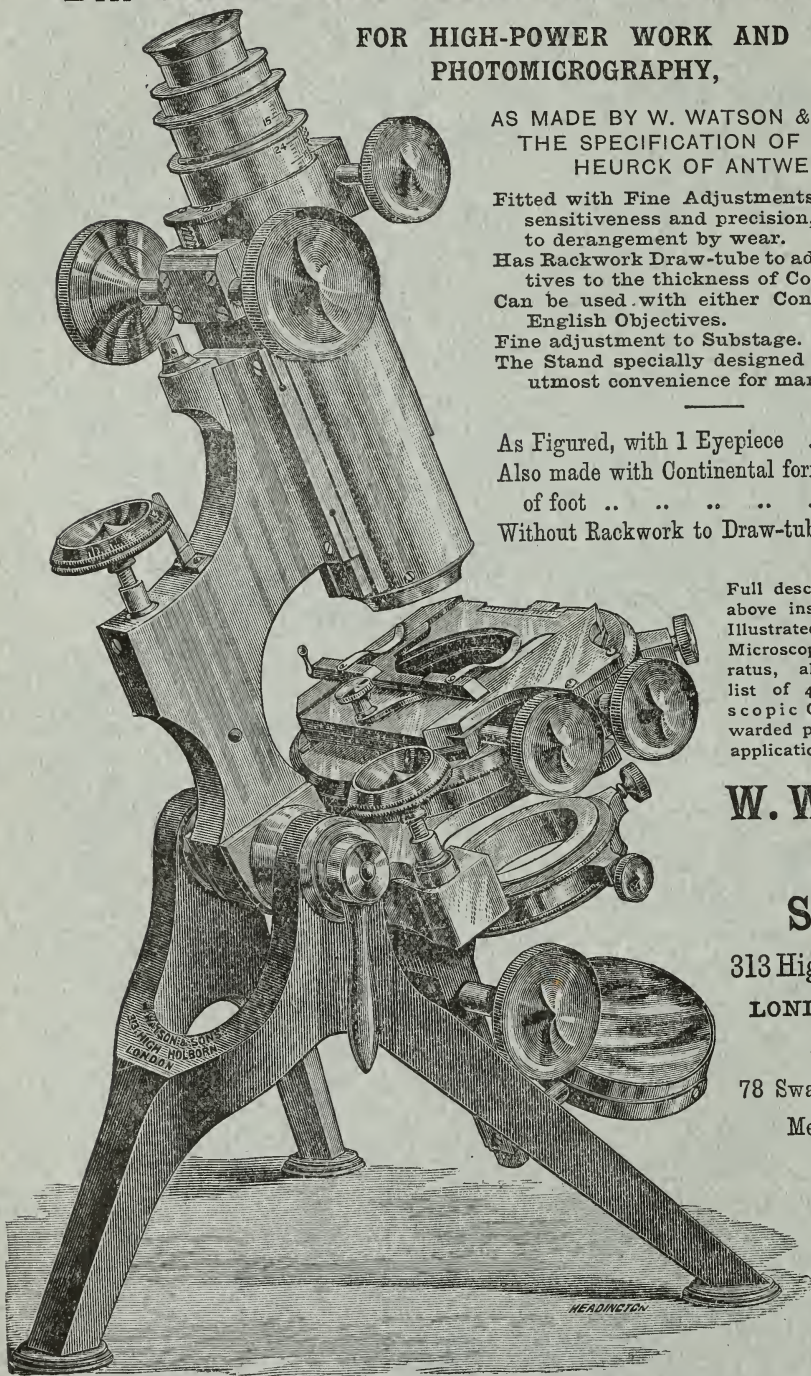
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JOURNAL
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OCTOBER 1892.

TRANSACTIONS OF THE SOCIETY.

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X.—*Heterosporium asperatum* (Berk.) Mass., a Parasitic Fungus.

By GEORGE MASSEE.

(Read 19th October, 1892.)

PLATE VIII.

THE above-named minute fungus has been under observation for the past four years, and all statements in connection with its development and mode of life have been corroborated by repeated cultures and experiments.

It is a common and destructive parasite on the leaves of plants belonging to the order Liliaceæ, and has been observed on plants

EXPLANATION OF PLATE VIII.

- Fig. 1.—*Heterosporium asperatum*, on portion of a leaf of *Smilacina stellata* Desf., nat. size.
- „ 1a and 2.—Spores germinating in a sterilized solution of the host-plant (20 hours). $\times 500$.
- „ 3.—Spores germinating in a solution of the host-plant (48 hours); a, secondary spores; b b, anastomosing hyphæ. $\times 500$.
- „ 4, 5.—Spores germinating in water (80 hours); a, secondary spores; b, anastomosing hyphæ; c, a hyphal branch that has formed a loop by curving and anastomosing with the parent hypha. $\times 500$.
- „ 6.—Old sporophores that have produced secondary spores after remaining in water for four days; a, secondary spores; b, sporophores. $\times 500$.
- „ 7.—Spore germinating in a solution of leaf of sunflower; a, sessile whorls of secondary spores. $\times 500$.
- „ 8.—Spore germinating in water containing a trace of glycerin. $\times 500$.
- „ 9.—A fascicle of sporophores bearing spores; a, the sclerotoid base from which the sporophores spring; b, a portion of the hyphæ that produces the sclerotoid base. $\times 500$.
- „ 10.—A stout hyphal branch running between the cells of the host-plant, and giving off slender branches that penetrate into the cells of the host. $\times 500$.
- „ 11.—A stout, dark-coloured portion of mycelium growing in a dead leaf, and bearing two sclerotia. $\times 500$.
- „ 12.—A sclerotium producing secondary spores in a solution of the dead leaves of the host-plant (80 hours). $\times 500$.
- „ 13.—A pycnidium produced by stout, dark-coloured hyphæ in a dead leaf of the host-plant. $\times 500$.
- „ 14.—Section of a portion of the wall of a pycnidium, showing the origin of the pycnospores. $\times 500$.

belonging to the following genera—*Convallaria*, *Smilacina*, *Smilax*, *Polygonatum*, and *Maianthemum*.

In common with many parasites, the fungus does not appear on the surface until the leaf becomes more or less dry and discoloured, and on this account its presence has been considered by some as the result rather than the cause of the disease; but in reality the vegetative mycelium is present in the tissues of the leaf for some time before there are any external signs of its presence.

In *Smilacina stellata*, as in other host-plants of the fungus, the tip of the leaf has a slight oblique twist that retains a small quantity of moisture, and it is at this point that the parasite very frequently first shows itself; the secondary spores being caught, and their germination favoured by the film of water present; nevertheless, it may be stated that a yellow patch is often present at the point indicated, in which no trace of mycelium can be detected, and which appears to be entirely due to the action of water.

In other instances one or more yellow patches, caused by the mycelium of the fungus, appear at different points on the surface of the leaf.

The mycelium is not perennial in the host, never extending beyond the leaf in any species that I have examined, but the leaves are attacked and much disfigured while still in their prime, or in many instances even before they are full-grown.

Experiments show that the secondary spores are transported by some external agent—probably wind—on to the surface of the leaves, and that they are retained at those points that happen to be moist. During a dry period certain leaves of *Smilacina* were moistened at particular points with water containing a trace of glycerin to prevent rapid desiccation; at the end of six days several of the moistened spots became yellow, and an examination revealed the presence of mycelium; in about fourteen days the fasciculate sporophores of the fungus showed themselves at the surface. The above experiment was conducted with plants that were growing on ground covered with the fallen leaves of the previous season, and these furnished the secondary spores in abundance. The disease was also produced by direct application of the secondary spores to damp portions of the surface of the leaves, and although morphologically there appears to be but one species of the fungus under consideration, yet there are what may be termed distinct biological forms of this species; the secondary spores produced by the fungus developed on one species of host-plant rarely cause the disease when sown on the leaves of a host belonging to a different genus, although both species of host have their own form of the fungus.

The secondary spores, which will be described in detail later on, usually germinate within twelve hours of being placed in water, and emit from one end a single, unbranched, very sparsely septate tube

about $1.5-2 \mu$ in diameter; this mycelium, when produced on the surface of a suitable leaf, soon enters by way of a stoma into the interior. When once within the leaf, the mycelium at first forces its way between the cells of the host, the main branches soon acquiring a thickness of $8-10 \mu$, and becoming transversely septate, the cells averaging 2-3 times as long as broad (fig. 9); by degrees the walls of the hyphæ become tinged brown, and with age are dark brown and nearly opaque. The cells of the mycelium each contain one or more small, highly refractive, oleaginous globules, which disappear when treated with an alkaline solution. Thinner lateral branches are given off at intervals by the hyphæ described above; these at once pierce the wall of an adjacent cell, pass into the interior, and form a complicated coil (fig. 10); their function being that of assimilating food at the expense of the contents of the cell. These filamentous haustoria remain colourless, and contain granular protoplasm so long as their functional activity continues, but become brown like the parent hypha when the contents of the cell are exhausted.

The main branches of mycelium run between the epidermal cells of the upper surface of the leaf, and the haustoria penetrate into the interior of the cells of this layer. Within a fortnight after first entering the leaf, the mycelium has usually radiated from the point of injection and formed a more or less circular patch about 1 cm. in diameter, and of a pale yellow colour; this patch has now sunk below the ordinary surface-level of the leaf, owing to the collapse of the epidermal cells. In the meantime numerous short, lateral branches of the primary hyphæ have developed a pseudoparenchymatous mass of tissue at the apex, the superficial cells of which give origin to the sporophores (fig. 9). The sporophores, owing to their mode of origin, are fasciculate, varying in number from four to ten, and sometimes emerge from the substance of the leaf through a stoma, at others by rupturing the epidermis. The sporophores, when fully developed, measure $120-150 \mu$ in length by $8-10 \mu$ in diameter, and are divided into 6-9 cells by transverse septa; the basal cell, resting on the sclerotoid base, is inflated. The walls when matured are brown, becoming paler upwards. The terminal cell bears 2-4 very short, slender outgrowths, or sterigmata, that bear the spores. During the growth of the sporophores, the basal cells of the sclerotoid base send out colourless hyphæ; these penetrate the cells of the host for the purpose of obtaining food (fig. 9).

The young spores are one-celled and furnished with a colourless, very thin episporium. As growth proceeds, a transverse median septum is formed, and at this stage the episporium becomes very slightly tinged with olive, and the minute external warts with which it is studded at maturity make their appearance. At a later stage two more transverse septa are formed simultaneously, one at each side of the first formed septum. In rare instances two additional septa are formed in

centrifugal order, thus producing a six-celled spore. The mature spore is slightly constricted at the septa.

The spores are produced in short chains in acropetal order. When the basal spore is nearly mature, a minute papilla appears at its apex; this papilla gradually increases in size and forms a second spore, which in turn gives origin at its apex to a third spore. I have never seen more than three spores in a chain.

When the basal spore of the chain is mature it falls away from the sporophore, carrying the immature spores along with it; the latter consequently attain their full size, often from a very small beginning, after becoming free from the sporophore and from each other. This explains the presence of spores of various sizes and with a varying number of septa, seen on examining microscopically species of *Heterosporium*, *Helminthosporium*, and *Cladosporium*. The gradual growth of young isolated spores can be readily followed in a nutritive medium.

The minute projections on the episore gradually increase in size until the spore is mature. Prominences on the episore are produced by two distinct methods; in the present example, if a nearly mature spore is plasmolysed after its contents have been stained, it will be seen that the protoplasm is attached to the inside of the episore by very fine strands at those points corresponding to the minute projections on the outer surface. A similar condition of things may be observed in many other acrogenously formed spores. These warts or spines, as the case may be, must be looked upon as due to localized points of growth, caused by the continued contact of the epiplasm with the cell-wall, and not as being due to the apposition of matter, as considered by some observers.

The second type of episore ornamentation is met in the ascospores of various species of subterranean fungi belonging to the genera *Tuber*, *Sphaerosoma*, *Hydnobolites*, &c., the zygospores of *Syzygites*, and the oospores of species of *Cystopus*, *Plasmopora*, and *Peronospora*. The wall is in all cases thick, at first smooth but eventually, owing to local contraction, it becomes irregularly rugulose, nodulose, or furnished with prominent ridges or plates, which in some species anastomose to form a more or less regular network resembling a honeycomb. The markings on the spores of all Myxogastres are due to this method of local contraction of the external surface of the spore.

If spores of the present type are treated for some time with dilute potassic hydrate the contracted portions swell, and the wall becomes smooth and even, whereas this is never the case with those spores where the projections are due to local growth of the episore.

At the moment of maturity, the spores germinate within twelve hours, when placed in a suitable medium. Each cell of the spore is capable of giving origin to a germ-tube, but this rarely occurs; as a

rule a germ-tube issues from each end of the spore, a third being sometimes formed from an interstitial cell. When germination takes place in water, whether in an artificial culture or in a drop of water on the surface of a leaf of the host-plant, the germ-tubes are very slender, rarely more than 1.5μ thick, equal, simple or sparingly branched, spirally curved, transverse septa very rare, and the fusion between originally distinct tubes or branches very rare, or in most cases entirely absent (figs. 4 and 5). About two days after germination has commenced, one or more short lateral branches spring at right angles from the germ-tubes; these may be considered as specialized sporophores. The apex of each sporophore becomes slightly incrassated, and within a day produces several simple or branched concatenate chains of elliptical, pale olive, smooth secondary spores, measuring about 3 by 1.5μ when mature. These secondary spores are developed in acropetal order (fig. 4a).

The mode of germination, relative thickness of the germ-tubes, and number of chains of secondary spores vary considerably, depending on the medium in which germination takes place, the characters being constant within certain limits in each case.

When the spores germinate in a sterilized solution of the host-plant (*Smilacina stellata*), the germ-tubes measure $5-6 \mu$ in diameter at the point of origin from the spore, become elongate, never spirally twisted, and gradually taper to the apex; transverse septa are abundant; the clusters of secondary spores are about equal in number, and the secondary spores of the same size as those produced on the very slender germ-tubes formed by spores germinating in pure water (fig. 3). In both instances sporophores bearing clusters of secondary spores are not unfrequently produced directly by interstitial cells of the spore without the intervention of a germ-tube (fig. 3a + and fig. 5a +).

Spores germinating in a solution of sunflower leaf produce a single germ-tube from the basal cell of the spore, the tube is $4-5 \mu$ thick at the point of origin from the spore, sparingly branched, tapering, straight, transversely septate, and usually bearing three or four sessile whorls of branched chains of secondary spores. These secondary spores when placed on moistened portions of the leaf of a sunflower germinated as usual, but there was no evidence of the germ-tubes having penetrated into the interior of the leaf, but similarly produced resting spores readily infected the leaves of the species of host-plant from which the material that produced the resting spores was obtained. This experiment, with others of a similar nature, proves that the secondary spores may, without any disadvantage, be produced in media differing widely from that in which the mother-spores were produced; and, furthermore, in some instances it was observed that secondary spores so produced germinated more readily on the normal host-plant, and produced more vigorous mycelium,

and a greater number of sporophores than others that were developed throughout the entire life-cycle on the same host-plant. Secondary spores formed in pure water invariably produced smaller patches of disease than those formed in a nutritive solution, and in many instances the germ-tubes of such secondary spores were quite rudimentary, and never penetrated into the tissues of the host-plant.

When spores are sown in water containing 1 per cent. of glycerin a single sporophore is almost invariably formed at one end of the spore, and this bears at its apex a comparatively large head of catenulate secondary spores.

The difference produced by spores germinating in different nutritive solutions manifested itself in the relative development of the germ-tubes, and the proportion of secondary spores produced; the size, form, colour, and power of germination of the secondary spores being the same in all the cultures.

Throughout the summer months the spores germinate as soon as mature, at the ordinary temperature of the air; but the later batches of spores produced in September and October will not germinate, or very feebly, at the temperature of the air; such spores remain passive during the winter, and germinate the following spring. Nevertheless these are not resting spores—in the ordinary sense of the term—but will germinate at any period throughout the winter, provided the temperature be sufficiently high.

The spores will not germinate at all in water containing a 1 per cent. solution of either of the following substances:—sulphate of copper, oxalic acid, picric acid, tartaric acid. These substances are not in like manner detrimental to the germination of all kinds of spores: *Penicillium glaucum*, as stated by De Wèvre* and corroborated by myself, attains its full development in water containing 1 per cent. of tartaric acid.

During the four years of observation on the same beds of host-plants, I have been very much struck by the perfect freedom from disease of certain individuals, growing in the midst of others that were attacked by the parasite, and I find on experimenting that those specimens which are not affected in a state of nature, cannot be artificially inoculated by placing germinating secondary spores on moistened portions of the leaves, as can easily be done in the case of plants that already show symptoms of the disease. On one particular clump of plants of *Convallaria majalis*, I have not observed a trace of the fungus for four years; neither have I succeeded in artificially inoculating these particular plants, although repeated attempts have been made for this purpose during the past two years; whereas I have succeeded in infecting plants of the same species that have already shown symptoms of the disease, with portions of the same infecting material used in experimenting upon the impregnable individuals.

* Bull. Soc. Roy. Bot. Belg., xxx. p. 115.

The numerous failures recorded in attempting to corroborate statements in connection with the inoculation of certain species of plants with a particular fungus, appear to indicate that this immunity from disease is not an uncommon feature in plant life.

The above remarks naturally suggest the question, What are the causes that give to certain individuals immunity from a specific disease? On the solution of this problem would appear to depend the successful issue of the much desired knowledge that would enable us to protect plants from the wholesale destruction caused by fungi.

It is certain that we cannot eradicate noxious parasitic fungi; the present preventive method of combating these pests, although useful to some extent, does not suggest finality; and notwithstanding the amount of research connected with the life-history of parasitic fungi, it must be admitted that the general principles of an exact method of dealing with the subject from a practical point of view, remain to be discovered.

To return to the fungus under consideration. During the summer the isolated patches of disease that correspond to independent centres of infection, increase in size and run into each other, the whole leaf not unfrequently presenting a blackened appearance, caused by the dark-coloured hyphæ.

During the autumn the stronger branches of the vegetative hyphæ increase considerably in thickness, many of the cells becoming very much inflated and spherical and separated by deep constrictions, due to the transverse septa not increasing in diameter. Many of these stout hyphæ become more or less irregularly branched and contorted at the tip, the convolutions approach each other, and by repeated cell-formation produce a more or less globose sclerotium-like body, almost black externally, somewhat paler inside (fig. 11). These sclerotia are of small size, rarely reaching 1 mm. in diameter, and remain passive during the winter. In the following spring certain of the external cells of the sclerotia become more prominent than the rest, and eventually grow out in a radiate manner from the sclerotium as slender, colourless, septate hyphæ or sporophores, each producing at its apex a whorl of simple or branched concatenate chains of small, elliptical, olive spores that agree in every particular with the secondary spores borne on the mycelium of the germinating spores (fig. 12). The spores produced by the sclerotia, when placed on the leaves of the host-plant, produce the *Heterosporium*.

Fig. 6 represents two sporophores of the *Heterosporium* after remaining in water on a slide for four days; it will be observed that two slender filaments have developed, each bearing a fascicle of chains of spores similar to the secondary spores borne on the filaments of germinating spores.

Finally, if leaves infested with the *Heterosporium* are examined in the autumn, minute, blackish perithecia will in many instances be

found; these bodies are subglobose, slightly attenuated upwards, furnished at the apex with a minute aperture, and when mature have the inner surface covered with very short sporophores, each bearing at its apex a minute body, resembling in every respect the secondary spores of *Heterosporium* spores. These minute perithecia originate from mycelium closely resembling that of *Heterosporium*, but I have not seen any suggestion of a resemblance to these bodies in any of my cultures, neither have I succeeded in causing the spores of these structures to germinate; consequently their relationship or otherwise with *Heterosporium* is at present unknown; it is certain, however, that these bodies have no necessary control over the continued development of the *Heterosporium*.

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Primitive Segmentation of Vertebrate Brain.‡—Mr. B. H. Waters comes to the conclusion that the forebrain of Vertebrates is composed of at least two well-marked neuromeres. The first nerve arises in the same manner as the other cranial nerves, and indicates so far its segmental character. From the second neuromere there spring the optic diverticula in a manner entirely comparable to the other cranial nerves; this seems to show that, though highly specialized in existing Vertebrates, the optic nerve is homologous with the other segmental nerves. The midbrain also consists of two neuromeres, from which the third and fourth nerves appear to take origin. The hindbrain consists of six neuromeres.

It seems reasonably certain that the central nervous system of the primitive Vertebrate consisted of a series of symmetrical segments, all of which were intersomitic; the neuromeres of the head gave origin to their respective nerves precisely as did those of the cord to the spinal nerves. The striking fact of Vertebrate embryology—the rapid increase of the anterior brain, and its great differentiation—seems to account for the relatively greater size of the fore- and midbrain segments, and for their early degeneration; those, on the other hand, of the hindbrain, which remains more primitive in character, persist.

“Urmund” and *Spina bifida*.§—Prof. O. Hertwig publishes under this title a study in comparative morphology and teratology based on

* The Society are not intended to be denoted by the editorial “we,” and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, &c., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, and Reproduction, and allied subjects.

‡ Quart. Journ. Micr. Sci., xxxiii. (1892) pp. 457–75 (1 pl.).

§ Arch. f. Mikr. Anat., xxxix. (1892) pp. 353–503 (5 pls.).

observations of abnormal frog ova. The abnormalities were produced by polyspermy and over-ripeness. First he describes abnormalities of segmentation; secondly, cases in which more or less large parts of the yolk remained undivided; thirdly, disturbances of gastrulation resulting in imperfect closure of the blastopore, primitive groove, or "Urmund," and consequent malformations. The "Urmund" may remain open throughout its entire length, or the closure may be partial, or almost complete. According to Hertwig the Urmund cleft originally divided the central nervous system into two halves of a ring, and this view is corroborated by the abnormalities in which closure is inhibited.

After describing the various malformations to which incomplete closure of the Urmund gives rise, Prof. Hertwig discusses similar malformations in other Vertebrates—Terata mesodidyma and kata-didyma in Teleostei, and Spina bifida in Amniota.

Prof. Hertwig believes that the original Urmund extended along the whole dorsal surface of the embryo. The dorsal groove represents the line of union of the Urmund-margins. The middle layer arises in reality altogether from a process of coalescence along these margins. It is important to notice Hertwig's statement that "what we term at different stages the Urmund is not one and the same unchanged and persistent organ, but rather different areas of an organ which is renewed by growth posteriorly as it becomes used up anteriorly by concrescence and differentiation." It is not, however, possible for us to give here a just summary of the author's restatement of the concrescence theory of His, or his interpretation of the various forms of Vertebrate gastrulation. In a subsequent section the author defends his cœlom theory against Goette's critique. He then passes on to show how the Urmund is related to malformations of various sorts. The last section is devoted to answering the question how in a simple egg multiple rudiments of organs may arise. The author concludes that in an over-fertilized (polyspermic) ovum, different factors conflict; on the one hand, forces tending to development and incited by the fertilization, on the other hand, influences of an inhibiting and disturbing kind due to the injury which the ovum has sustained by overmaturation or other disadvantageous conditions operating before fertilization. As the first or the second factors predominate the result of development varies.

Embryos of Apes.*—Prof. J. Kollmann gives a short account of an embryo of *Cercopithecus cynomolgus* from Sumatra. It measured 9.5 mm. in length. The back was slightly curved, while the pelvic curvature was strong and continued into the tail, which lay bent forward as far as the forehead. The strong tail was relatively larger than in the adult. After removing the amnion the delicate character of the membrana reuniens anterior was noticeable. A comparison with human and other mammalian embryos made it likely that the age of this fœtus was about four weeks. The head was larger than the trunk. Neither head nor trunk suggested anything pithecoïd. The Wolffian ridge, giving origin to the appendages, was sharply defined off from the proto-vertebral region, which exhibited eight cervical, twelve thoracic, six lumbar, six sacral, and many caudal segments. In the cervical region the

* Anat. Anzeig., vii. (1892) pp. 335-40.

protovertebral ridge was split into a ventral and a dorsal limb both segmented, a fact hitherto unnoticed in the development of mammals. In front of the eight cervical segments there were three distinct segments on the dorsal limb above mentioned. The relation of the double metameric ridge to the musculature of the neck is then briefly discussed, and a full description is promised.

Surface Views of Frog Embryos.*—Herr F. Ziegler in endeavouring to construct correct models of the embryos of *Rana temporaria* when the blastopore is closing and the neurenteric canal being formed, has observed the surface appearance of living embryos. Of this he gives a number of figures, to a description of which his communication is devoted.

Alleged Parthenogenesis of Frog Ova.†—Dr. H. Dehner gives an account of alleged cases of parthenogenetic segmentation in Vertebrate animals and communicates the results of his own observations on *Rana fusca*. With all possible precautions he removed ova from a female frog taken from the sexual embrace, placed them in water, and examined them after 24 to 48 hours. About 1500 ova were thus examined. In one hundred of these unfertilized eggs three showed irregular segmentation furrows. The groove-like insinking of the surface, the occurrence of partial constrictions of more or less spherical form, the limitation of these changes to the clear pole of the ovum, and the behaviour of the pigmentation were strikingly suggestive of what occurs in the normal segmentation of a fertilized egg.

Segmentation of Cephalic Mesoderm in *Pelobates fuscus*.‡—Mr. A. N. Sewertzoff finds that there are, in the head of *Pelobates fuscus*, three pairs of mesodermal segments, each of which corresponds to a body-segment. The external segments of Götte are not mesodermal in origin, but are ectodermal structures and have no relation to segmentation. In other words, the segmentation of the head of anurous Amphibia belongs to the type commonly found in lower Vertebrates.

Development of Elasmobranchs.§—In the present set of "notes" Mr. A. Sedgwick deals with (1) the formation and growth of the embryo, and the blastopore; (2) the formation of the mouth and gill-clefts; and (3) the segmentation of the cephalic mesoderm and the development of nerves. He finds that, immediately before closing, the blastopore of Elasmobranchs is an elongated narrow slit, slightly dilated in front and more dilated behind. Between these two points it takes the course of a reversed letter S. The anterior part perforates the floor of the medullary canal and is dorsal; this is continuous round the end of the tail with a ventral part, which extends forward along the ventral side of the tail, as far as the yolk-stalk, along which it passes to continue backwards along the yolk. The behaviour of the blastopore of Elasmobranchs, in its relation to the anus, neurenteric canal, and growing point, very closely resembles that of the Frog as described by Assheton and Robinson.

* Anat. Anzeig., vii. (1892) pp. 211-5 (3 figs.).

† Verh. Physik. Med. Gesell. Würzburg (Semper), xxvi. (1892) pp. 1-18 (1 pl.).

‡ Bull. Soc. Imp. St. Petersburg, 1892, pp. 99-103 (1 fig.).

§ Quart. Journ. Micr. Sci., xxxiii. (1892) pp. 559-86 (1 pl.).

The first rudiment of the mouth actually extends into the rudiment of the pituitary body; all the arches are diverted backwards, and the mandibular most of all; this appears to be due to that flexure which is ordinarily called cranial, but would better be called cephalic.

Three views have been put forward as to the origin of the peripheral nerves; that which the late Prof. Balfour preferred, but which he rejected on the ground of want of supporting evidence, was the doctrine of Hensen that the rudiments of the nerve-fibres are present from the beginning as persistent remains of the primitive connections between the incompletely separated cells of the segmented ovum. Mr. Sedgwick is now able to supply the needed evidence, for he can certify that there is not a complete separation of the cells of the segmented ovum. Subsequent to cleavage the cells of the young embryo are connected by delicate processes, often extremely fine; these unite together into networks below the epithelial arrangement of the protoplasm which is characteristic of the surfaces. This network is often of a very loose mesh and its fibres are always delicate; and it is, doubtless, often torn and destroyed by the preserving processes to which the embryo has to be subjected. But Mr. Sedgwick assures us, delicate as it is, there can be no doubt of its existence in Vertebrate embryos; and there can be no reasonable doubt that it is derived from the processes and strands left between the cells, as a result of the incomplete cleavage of the ovum. However, it still remains to be shown that the nerve-fibres are derived from it.

Utero-gestation in *Trygon Bleekeri*.*—Dr. A. Alcock reminds us that one of the most interesting discoveries made by the Indian survey steamer 'Investigator,' is that there are certain Elasmobranch fishes in which the female develops during pregnancy a vast system of uterine glands that secrete a nutrient fluid or uterine milk for the nurture of the developing embryo. Having had the opportunity of examining two pregnant specimens of *Trygon Bleekeri*, he tells us that he found the single uterus to contain a single naked fetus unattached structurally to the mother; the uterine mucous membrane was produced into long villi, which consisted almost exclusively of blood-vessels and glands. The viscid, turbid, or milky secretion of the latter was found free in the uterine cavity. The secretion was further observed unchanged in the spiracles and in coagula filling the duodenum and anterior part of the spiral gut of the fetus.

Embryonic History of *Pteroplatæa micrura*.†—Dr. A. Alcock, who with Prof. Wood-Mason has already shown that in *Pteroplatæa micrura* the ovum is retained within the uterus and that the uterine mucous membrane is furnished with nursing filaments or trophonemata, which secrete a "milk" that supplies the embryo with nutriment, now gives some interesting observations on the embryonic history of this fish. The embryo when 29 mm. long has a remarkable generalized shark-like form. The broad cord by which it is attached to the large yolk-sac is traversed by channels which do not contain blood-cells but only spherules of yolk. The total volume of the gill-filaments was not less than one-third that of the entire embryo. Each filament is nothing

* Ann. and Mag. Nat. Hist., ix. (1892) pp. 417-27 (1 pl.).

† Op. cit., x. (1892) pp. 1-8 (1 pl.).

more than a long narrow loop of a capillary of wide bore with a wall one cell thick, enclosed in a folded sheet, also only one cell thick, of small epithelial cells which consist of little but a great nucleus. These filaments enfold the yolk-sac and seem to assist in absorbing the nutrient yolk.

After reminding us that the modes of reproduction among Elasmobranchs are three—(1) oviparity, (2) viviparity with the formation of a placenta, and (3) viviparity without the formation of a placenta, Dr. Alcock offers some suggestions as to the origin of a placental viviparity among Elasmobranchs, in which he expresses the belief that the second mode arose directly from the first of these, and the third from the second.

Mesoderm of Teleostean Fishes.*—Mr. E. R. Boyer has especially studied (in the Cyprinodont *Fundulus heteroclitus*) the share taken by the mesoderm in the formation of the pectoral fin. He first, however, describes the formation of the primitive layers and the differentiation of the protovertebræ and lateral plates, the differentiation and early development of the mesoderm in the pectoral region, and the origin and fate of the “intermediate cell-mass.” With regard to the origin of the pectoral fin the first step is a differentiation in the somatopleure caused by cell-proliferation in the region of the nephrostome. This process leads to the formation of the pectoral plate. Between this last and the four most anterior myotomes a connection is formed, and elements from the peripheral layer of these myotomes are contributed to the pectoral plate. The head-mesoderm does not really appear to be concerned in the earliest formation of the pectoral fin.

The ectodermal fold of *Fundulus* does not begin to be formed until several days after the formation of the pectoral plate in the mesoderm; there is not in this Fish any trace of a continuous longitudinal modification of the ectoderm along the side of the embryo, such as has been observed by Balfour and by Ryder.

Formation of Germinal Layers of Petromyzon.†—From his study of *Petromyzon*, Mr. S. Hatta concludes that the formation of the germinal layers accords well with the general plan of the development of these layers in Vertebrates, as shown in *Amphioxus*, *Triton*, and *Rana*, *Trionyx* and *Clemmys*, and it is, therefore, unnecessary for us to enter into detail. Calberla, Scott, Shipley, and Kupffer have already studied the subject, and it is with the first of these that Mr. Hatta's results mainly agree.

Development of Blood-corpuses.‡—Dr. O. Van der Stricht finds that the first blood-corpuses appear at the level of the area vasculosa and at the expense of mesoblastic elements. They all present the characters of red corpuses. The white cells appear later in the circulation, and also arise from mesoblastic elements formed outside the capillaries. From the time of their appearance the red and white corpuses are distinct in structure and origin.

The multiplication of blood-cells already formed continues in the

* Bull. Mus. Comp. Zool., xxiii. (1892) pp. 91-134 (8 pls.).

† Journal Coll. Sci. Imp. Univ. Japan, v. (1892) pp. 129-47 (2 pls.).

‡ Arch. de Biol., xii. (1892) pp. 199-344 (6 pls.).

circulation generally, but especially in the hæmatopoetic organs, the liver, spleen, and osseous medulla. The proliferation of blood-cells is favoured by physiological influence. Multiplication also goes on in other vascular regions where blood pressure is very feeble; as at the level of the venous capillaries of the *area vasculosa*, in the capillaries of the buds of the lower limbs, in the interior of the capillaries of all the visceral organs, near those of the subcutaneous tissue, and in those which are near the central nervous system.

The red corpuscles of mammals owe their origin to erythroblasts whose nucleus has left the cell, and undergone, later on, an extracellular, or even an intracellular destruction. There is no relation between leucoblasts and erythroblasts; they present distinct characters in all stages of their development. All the blood-cells multiply by mitosis; the erythroblasts when undergoing indirect division may be recognized by a delicate border of homogeneous protoplasm. The leucoblasts are recognizable by the existence of a wider zone of protoplasm, similar to that which characterizes these elements when in a state of repose. Leucoblasts with eosinophilous granulations are formed at the expense of white cells with finely granular protoplasm, or at that of leucoblasts with eosinophilous granulations which are ready to multiply by mitotic division.

Cells with budding nuclei are only met with in the hæmatopoetic organs of Mammals. They do not take any direct part in the formation of the red corpuscles. They absorb nuclei and the débris of erythroblastic nuclei, and contribute to the formation of adenoid tissue, in the meshes of which the blood-cells multiply and develop.

Two kinds of giant-cells are found in the hæmatopoetic organs of Mammals. Some of the megalocaryocytes have abundance of protoplasm; these should be regarded as elements which have still to fulfil the functions of phagocytosis and the formation of adenoid tissue. Others have little protoplasm and a very chromatic nucleus, and should be considered as elements which have reached the last stage of life, and whose protoplasm has been used up.

The adenoid tissue which serves as the framework for the blood-corpuscle in several hæmatopoetic organs arises at the expense of a variety of the white globules. These give off ramified prolongations which anastomose with adjacent prolongations. In the hæmatopoetic organs of Mammals the giant-cells also contribute to the formation of this trabecular system.

The liver of Mammals passes through three stages; in the primitive stage it is formed of a reticulum of cellular hepatic tubes, and in the meshes of this the blood circulates. Young blood-cells stop in it and multiply by indirect division. This primitive stage is persistent in the Amphibia. The second is a truly embryonic stage, in which the liver may be considered as a true hæmatopoetic organ, just as much as the osseous medulla. New blood-forming capillaries appear in the interior of the hepatic cords, where they form white and red corpuscles. In the final stage the liver takes no part in the formation of blood.

Three stages may likewise be distinguished in the development of the spleen. In the first stage there is no differentiation into splenic pulp and Malpighian corpuscles. The erythroblasts and the leucoblasts

multiply in the meshes of the reticulum of adenoid tissue. In the second stage there are Malpighian corpuscles within which new leucoblasts are formed by indirect division, and there is a splenic pulp which is reserved for giant-cells and erythroblasts which divide by mitosis. In the third or adult stage the pulp does not seem to take any part in the formation of new red blood-corpuscles, and there are no giant-cells.

The osseous medulla of Mammals differs much from that of Birds; in the latter the venous capillaries have a continuous endothelial wall; in consequence of this the blood circulation does not pass through them, and the erythroblasts are developed and multiply only within the blood-forming capillaries. The various kinds of white cells pass by diapedesis through the endothelial wall, and multiply outside the vascular plexus. In Mammals the walls of the venous capillaries are discontinuous; the blood passes by the opening, and penetrates freely into the meshes of the adjacent adenoid tissue; within the plexuses the erythroblasts and leucoblasts divide and develop.

Studies on the Blood of Amphibia.*—In this memoir Dr. A. B. Macallum deals with the origin of hæmoglobin, the fusiform corpuscles, and the origin of the hæmatoblasts. As to the first point he finds that the hæmoglobin of the blood-corpuscles is derived from the abundant nuclear chromatin of the hæmatoblast. The fusiform cells of Amphibian blood are derived from the red corpuscles, which lose their cell-membrane, and the greater portion of the discoplasma. The hæmatoblasts of *Amblystoma* are direct descendants of cells split off from the extreme ventral portions of the visceral mesoblast, and they pass, at first, a portion of their existence in a specialized part of the original body-cavity of the embryo.

Origin and Evolution of Mammalian Teeth.†—Prof. W. Kükenthal discusses this difficult question. Some think the milk teeth a secondary acquisition, others regard them as primary, and Baume suggests that both sets are secondary, the original dentition being regarded as a homodont reptilian-like series, of which some members are suppressed with the shortening of the jaws, while others are modified to appear subsequently as the final set. The fact is, that the succession of teeth in Mammals has not yet been explained. Kükenthal starts from the teeth of toothed whales, which in most cases form a uniform homodont series, but even apart from the narwhal, the series is not always quite homodont, as an examination of the dentition of embryos of *Phocæna communis* shows. It is generally believed that these teeth represent the second set. Weber, Julin, and Winge have, with slight differences, supposed that in association with the long jaws both sets of teeth appear together and are indistinguishable. But Kükenthal maintains that the teeth of toothed whales represent a true milk dentition. He bases his conclusion on the fact that the second set is present in rudiment in embryonic life, but afterwards disappears.

This fact leads him to reject all hypotheses according to which the toothed Cetaceans are primitive homodont and monophyodont animals,

* Trans. Canadian Institute, ii. (1892) pp. 221-60 (1 pl.).

† Jenaische Zeitschr. f. Naturwiss., xxvi. (1892) pp. 469-89.

or forms in which both sets are mingled. The fact is also against the theory that the milk dentition is a secondary acquisition. Perhaps the abortion of the secondary set may be connected with the diet of the toothed Cetaceans. The baleen whales should be ranked in a distinct order, without close genetic relation with the toothed forms. That they too were originally heterodont seems to Kükenthal to be indicated by the occurrence in the embryos of peculiar composite teeth like molars.

The author pronounces strongly against the theory which would connect Cetaceans with seals through *Zeuglodon*. He also discusses the dentition of Marsupials, which his embryological investigations (on one species) have led him to regard as a first, not as a second set. Only one tooth of the rudimentary second set comes to development. Everything seems to Kükenthal to point to the conclusion that the oldest Mammals were diphyodont. Both sets are equally primitive.

Kükenthal's general theory of the evolution of teeth may be summarized as follows. The lowest grade is that of Elasmobranchs where the dermal denticles are diffuse, but attain special development on the jaws, and are replaced without limit. The second grade occurs in Amphibians and Reptiles, in which the teeth are not diffuse, but restricted to the jaws, limited in number and in replacement. The third grade is that of Mammals, in which of the lateral rows of teeth, only the two well-known sets persist. With the shortening of the jaws the conical teeth become fused in the original multituberculate molars, of which the lines of specialization are now known with some definiteness.

Development of Rodent Teeth.*—Herr P. Freund corroborates the observations of Chabry and Pouchet as to the occurrence on the upper and lower jaw of *Lepus* of a rudimentary tooth in front of the large incisor. He inclines to regard it as a much reduced milk-tooth corresponding to the large incisor. Herr Freund finds in the diastema on the upper jaw of *Lepus* a well-developed dental ridge without enamel-germs. This ridge is indistinct in *Cavia*, absent in *Cricetus* and *Mus*. In *Sciurus*, however, the ridge is uninterrupted, and, besides Stenson's duct, there are two closely apposed enamel-germs, of which the more anterior is the more distinct. These are perhaps vestiges of posterior incisors or of canines.

Pœcilogony.†—M. A. Giard returns to this subject,‡ being drawn to it by the recent observations of Messrs. Brook and Herrick on the metamorphosis of the Macroura.§ He points out that pœcilogony shows us in the clearest way by what processes all extended embryogeny becomes abbreviated. From the taxonomic point of view the phenomena are also very important; a number of species of Insects are based on differences in development. In species of pœcilogonic origin the differentiation is not such as to prevent a certain amount of successful crossing; in converging species, when the distinction has existed for a long time, crossing will be sterile or impossible. For example, the different species of *Typhlocyba*, of the section *T. rosæ*, are in a state of forced amixia, owing to the great differences in the copulatory organs; and yet these

* Arch. f. Mikr. Anat., xxxix. (1892) pp. 525-55 (2 pls.).

† Comptes Rendus, cxiv. (1892) pp. 1549-52.

‡ See this Journal, 1891, p. 332.

§ See ante, p. 476.

species are very difficult to distinguish from one another. The comparison of pœcilogonic and convergent forms explains to a certain point the differences which exist in the crossing of various wild species, and which have offered so much difficulty to the philosophers.

When embryological condensation is carried very far it gives rise to progenesis, which still further complicates pœcilogony, as in the Axolotl or in Chun's examples of Ctenophora. Finally, obligatory parthenogenesis, which the author has shown to be the result of the condensation of development carried as far as the early phenomena of oogenesis, may be added to pœcilogony; examples are found (as "heterogony") among Trematodes, Aphides, and others.

β. Histology.

The Animal Cell.*—Prof. J. Chatin, well known for his useful and easily read accounts of scientific subjects, has published a small volume on the structure and life of the animal cell, in which the various biological phenomena are successively dealt with. The concluding chapter gives some hints on the way in which the cell should be studied.

Attraction Spheres and Central Bodies.†—Dr. O. Bürger attempts to interpret these structures. E. van Beneden believes that the attraction sphere with its central corpuscle is a permanent organ of the cell, "au même titre que le noyau lui-même." Boveri also describes the centrosoma as a distinct structure. Recent investigations have proved the occurrence of attraction spheres and centrosomata in many different kinds of cells, both of plants and animals. But what do these structures mean? According to Bürger the sphere and its centre is not an organ of the cell, but rather a phenomenon due to mechanical processes occurring within the plasma. The centre is a ball of protoplasm around which the microsomata are arranged in a concentric sheath; the centre is not the cause, but the result of the attraction of microsomata. That the central corpuscle can be differentiated by staining from the rest of the plasma may be merely an expression of its concentrated composition. Herr Bürger answers various objections which may be brought against his interpretations, and advances counter-objections against van Beneden's view.

Relation of Nucleus to Cell-substance during Mitosis.‡—Dr. H. F. Müller has investigated in this connection the hæmoglobin-containing blood-cells of the spleen in *Triton* and similar cells in Mammals. After the disruption of the nuclear membrane during metamorphosis substances of the cell-plasma do as such pass into the nucleus. Herr Müller regards this mingling of paraplasma and nuclear sap as of essential importance in the process of indirect division.

γ. General.

Influence of Fresh Water on Marine Animals.§—Don José Gogorza y González has studied in a more exhaustive manner than has hitherto been done the influence of fresh water on marine animals. After an

* 'La Cellule Animale,' Paris, 1892, 8vo, vi. and 304 pp., 149 figs.

† Anat. Anzeig., vii. (1892) pp. 222-31.

‡ SB. K. Akad. Wiss. Wien, c. (1891) pp. 179-88 (1 pl.).

§ Anales Soc. Españ. Nat. Hist., xx. (1891) pp. 221-70 (1 pl.).

historical introduction and a discussion of the physiological effects of fresh water on organisms unaccustomed to it, he submits a great body of facts illustrating the varied power of survival exhibited by those animals whose medium is changed. It will give some idea of the detailed character of Don Gogorza's investigations when we note that his observations extend to over seventy different species, from hydroids to fishes.

The proportion of deaths increased with the percentage of fresh water added to the salt. A certain amount of dilution all the marine animals experimented with seemed able to endure, but in each case there is a limit beyond which death rapidly ensues. This limit varies with the individual species, but not in correspondence to zoological relationships. In the various mixtures the Crustaceans showed themselves most sensitive to the presence of fresh water, the fishes least. In the great majority transference to fresh water is rapidly fatal. In average power of resistance the groups of animals stand thus:—Coelenterates least, then Echinoderms, Tunicates, Worms, Fishes, Crustaceans, and Molluscs. A great deal depends on the rate of endosmosis permitted by the skin and cuticle.

After a discussion of the causes of death in fresh water—by hydration of the tissues, turgescence of cells, coagulation of albuminoids, &c., the author discusses the power of gradual adaptation to fresh water, which, as is well known, is exhibited by not a few, especially littoral, marine animals.

Central Nervous System of Lower Animals.*—Prof. G. Retzius has, in his further investigations, made use of the methylen-blue method. In the study of Worms he finds that closely allied species behave differently to the stains, and for almost every species it is necessary to make some slight change in method so as to obtain the best results.

Attention was chiefly given to Polychæta and Hirudinea. There is an important agreement in the typical form of the elements of the nervous system of Worms, and in this they agree with the Crustacea. In both groups the ganglion-cell is, with rare exceptions, unipolar, and it gives off its process directly or indirectly to the periphery, where, as a nerve-fibre, it passes to its terminal branchings. On their course through the ganglia the trunk-processes give off secondary processes in various directions. These fine secondary processes generally branch dichotomously and repeatedly, and give rise to the chief mass of the dotted substance. There is formed an extraordinarily intricate plexus, or "neuropilem," but no network of anastomosing processes.

The composition and arrangement of the dotted substance is very different in various worms, and the elements themselves differ considerably.

Amphioxus lanceolatus and *Myxine glutinosa* fall under the head of lower forms. In the former there are all kinds of ganglionic cells; "true" and "untrue" unipolar cells; by the latter are meant cells which give off a thick process which soon branches, but the process is considered to be a part of the body of the cell. To this type belong

* 'Biologische Untersuchungen,' ii., Stockholm, 1891, large folio, 53 pp., 16 pls. See Biol. Centralbl., xii. (1892) pp. 413-6.

most of the giant-cells which are found in the hinder portion of the medulla.

With the giant-cells are associated small, spindle-shaped, bipolar cells; these ordinarily lie transversely to the longitudinal fibres; one process crosses the medulla, and the other passes into a sensory root or into the longitudinal bundles of the side on which the cell lies. Bipolar cells of other forms are described, and a few multipolar cells were observed. Some were triangular, and it is not easy to say whether they are ganglionic or epithelial, though they stain with methylen-blue.

Bearing of Pathology on Doctrine of Transmission of Acquired Characters.*—Dr. H. J. Tylden, who has since fallen a victim to bacteriological research, sums up the evidence afforded by pathology as to the transmission of acquired characters. He finds that pathology pronounces against the hypothesis of the transmission of acquired characters. At first sight there appears to be a mass of evidence in favour of it; but a number of these cases must be rejected, because, though there can be no doubt that the morbid characters here present are both acquired and transmitted, they are not acquired in the sense under discussion, and that is by the somatic cells exclusively, but by the whole organism. In other cases what is transmitted is not what is acquired, but something broader and more general. Genuine instances of acquired characters there are, but there is no evidence of their transmission.

B. INVERTEBRATA.

Mollusca.

a. Cephalopoda.

Minute Structure of Posterior Salivary Glands in Cephalopods.†—Dr. B. Rawitz has studied these organs in *Eledone moschata* and *Octopus vulgaris*. They are tubular glands consisting of a crowd of canals extending in all directions. A wide, slightly branched and coiled sac gives origin to many much ramified and coiled lateral sacs. The lateral sacs form the proper secretory portion, the main sac is rather conductive. The glandular region secretes albumen and mucin, and the albumen- and mucin-producing cells are histologically distinguishable. In neither of these two kinds of cells, which are described in detail, does the process of secretion involve the death of the cell. As in many other Invertebrates, the glandular cells are long-lived.

γ. Gastropoda.

Anatomy of some American Molluscs.‡—Mr. H. A. Pilsbry has notes on the anatomy of *Sagda*, *Cysticopsis*, *Ægista*, and *Dentellaria*. The genitalia of the large opaque *Helices* of tropical America show that the reference of all of them to the single genus *Caracolus* is a natural arrangement.

* Nature, xlvi. (1892) pp. 302-5.

† Arch. f. Mikr. Anat., xxxix. (1892) pp. 596-611 (1 pl.).

‡ Proc. Acad. Nat. Sci. Philadelphia, 1892, pp. 213-5 (1 pl.).

Vision of Gastropoda.*—Dr. O. Willem is led by his experiments to the conclusion that terrestrial pulmonate Gastropoda see very badly, and that they direct themselves principally by means of their olfactory and tactile sensations; they perceive a confused image of large objects at a distance of about a centimetre, but they do not get a distinct image of objects that are more than one or two millimetres off. Aquatic Pulmonates do not seem to have any distinct vision at any distance. As to moving objects, the terrestrial forms seem to distinguish them worse than fixed objects, and they appear to make no impression on aquatic forms. As to the effect of light, some seek it and some shun it; the amount of reaction differs in different species, but for a given species the reaction is in proportion to the intensity of the light. They have dermatoptic sensations, but the extent to which different species are affected varies considerably. They do not seem to be able to perceive ultra-violet rays.

Aquatic branchiate Gastropods do not appear to be able to distinguish form at all. The author has some notes on the structure of the eye in various Prosobranchs and Opisthobranchs, and points out that a retrogression in the structural characters of the eye often accompanies the migration of the eye into the tissue. Diminution may be seen in the size of the precorneal lacuna, the volume of the eye, and the number of retinal cells.

Morphology of Liver of Gastropoda.†—M. H. Fischer has made a study of the liver of Gastropods. In its development he distinguishes several stages. The hepatic tissue is preceded by a reserve-tissue which is formed by part of the endoderm. In typical cases (*Paludina*, *Sphærium*) it is the cells that are situated on the ventral wall of the archenteron which form the tissue. This transitory stage corresponds to the conformation of the digestive tube in adult Solenogastres, as described by Pruvot. The ciliated cells are localized on the dorsal median line, where they form the first rudiment of the stomach; on the ventral surface and on either side the walls are formed by the hepatic cells.

The stomach is completed by the appearance of cylindrical cells on the median line of the ventral surface. At this stage the median region of the digestive tube consists of three parts; the median stomach and two endodermic diverticula which open laterally into the stomach by a pair of orifices which gradually close. When the larvæ escape the nutrient reserve-substances are used up, and the hepatic lobes function as digestive organs (*Æolis*).

The hepatic lobes, in the third stage, are at first rounded; they break up into lobules and the liver is rapidly formed.

In discussing the principal variations of the liver M. Fischer deals first with the symmetry of the hepatic lobes. The two lobes of the embryo are equal and symmetrical in the Scutibranchiata (*Neritina*), and many other organs of these animals present the same peculiarity. Among the Pectibranchiata, *Valvata* alone has two symmetrical lobes, and it, like the Scutibranchiata, has a bipectinate gill. In all other Gastropods the two endodermic diverticula are unequal from the first

* Arch. de Biol., xii. (1892) pp. 57-149 (1 pl.).

† Bull. Sci. de la France et de la Belgique, xxiv. (1892) 87 pp. and 6 pls.

(*Paludina*), or rapidly become so, the left lobe being more developed than the right. In some cases (*Elysia*, *Arion*, *Buccinum*) the adult exhibits an acquired, secondary, bilateral symmetry.

In the number of the hepatic canals some Scutibranchs whose organization is very primitive (Fissurellidæ) have three distinct hepatic canals. The same is true of some Opisthobranchs (*Æolis*) and some Pulmonata, in which the left lobe is divided into two distinct masses. It appears to be a primitive arrangement among Molluscs for the two hepatic lobes of the embryo to divide, during development, into several masses which open separately into the stomach. In consequence of a simplification of the embryogeny and a condensation of the hepatic organ this complete division is not found in the more differentiated forms; but this apparent simplicity is no more primitive than the acquired symmetry already spoken of.

The general modifications of the liver cannot serve as characters for the different classes of Mollusca, but they are useful as means by which, in the different classes, the most primitive types may be sought for; the deductions from them agree with those drawn from the study of other organs.

The variations of the liver and its ducts in the Prosobranchiata are well suited for a study of the variations seen in a given group, for they are very considerable. On the whole, it is clear that there is in them an evolution comparable to that of other organs, for the liver of the highest Pectinibranchs is very different from that of the Scutibranchs or holostomatous Tænioglossata. At the same time, it is not to be supposed that the divisions which can be established by the use of the liver are always the same as those to which other organs incline us.

A slight comparison is instituted between the liver of Molluscs and that of some other Invertebrates. The liver of Brachiopods has exactly the same conformation and the same development as that of Lamellibranchs. In the embryonic stages of the Bryozoa the appearances are the same as in Molluscs, though the adult condition is very different.

Excretion in Pulmonate Gastropoda.*—M. L. Cuénot has improved on preceding methods of physiological injection by injecting into the cœlom of various Gastropods peptonized solutions containing one or more of a rather large number of staining reagents. The health of the animal is in no way affected if the injection is properly performed; the substances are very rapidly absorbed by the excretory cells, which are always contained in vacuoles.

By means of this process the author has been able to recognize three different excretory organs—the kidney, certain cells of the liver, and the large vesicular cells of the connective tissue (Leydig's cells). The vacuolated cells of the liver, which have been regarded as producers of ferment, are really excretory in function. The cells of Leydig are remarkable for the multiplicity of their functions.

The renal cells which normally excrete uric acid and other products have a very acid reaction, and the organ is certainly not an alkaline gland as Kowalevsky supposed. The part played by the liver of Pulmonata in excretion allies them to the Opisthobranchs, with which they have much in common. In *Aplysia*, *Doris*, and *Eolis*,

* Comptes Rendus, cxv. (1892) pp. 256-8.

the liver contains excretory cells with large vacuoles. In Prosobranchs, on the other hand, the liver appears to be purely a digestive gland, and takes no part in the excretion of injected substances.

Paired Nephridia of Prosobranchs.*—Dr. R. v. Erlanger was struck by the contradictory statements which have been made as to the reni-pericardiac duct of various Molluscs. He finds that *Trochus*, *Turbo*, and *Haliotis* possess a left reni-pericardiac duct only, while *Fissurella*, *Emarginula*, *Puncturella*, *Patella*, and *Tectura* possess no such duct. The genital products always pass through the right renal organ, either by bursting of the gonad through the walls of the right kidney (*Patella* and *Trochus*), or being admitted through a kind of valve (*Haliotis*), or transported to the right renal papilla by a special genital duct (*Fissurella*). The author concludes that the only remaining kidney in most Prosobranchs is the actual left one: that the actual right kidney has disappeared or become transformed, part of it forming part of the genital apparatus. He is quite convinced that the lamellar kidney of *Ampullaria* is homologous with the actual left kidney of *Paludina*, and the vascular sac of *Ampullaria* with the rudimentary right kidney in *Paludina*. The result of a comparative survey is that Dr. v. Erlanger comes to the conclusion that all the evidence tends to show that the Mollusca are true Cœlomate animals, and that the condition of the renal and genital organs is closely similar to that of primitive Annelids.

Colourless Globulin in Patella.†—Dr. A. B. Griffiths gives an account of a globulin from the blood of the limpet which is colourless and contains no metal. The author calls it achro[oglobine, and shows that it has a respiratory function.

Respiratory Value of Hæmocyanin to Helix pomatia.‡—M. L. Cuénot finds that hæmocyanin, in the snail, is capable of absorbing more oxygen than an equal volume of water, and undergoes changes in tint; its power of absorbing oxygen is, however, very much less than that of the hæmoglobin of Vertebrates.

Cerata of Nudibranchs.§—Prof. W. A. Herdman and Mr. J. A. Clubb discuss the innervation of these organs, and show that there are various arrangements of nerve-supply. They may be innervated entirely by the pleural ganglia, as in *Polycera* and *Ancula*, or chiefly by the pleural, with a small supply from the pedal by means of a pleuropedal anastomosis, as in *Dendronotus*, or entirely by the pedal ganglia, as in *Tergipes*, or chiefly by the pedal with a small independent accessory supply from the pleural, as in *Facelina*. If the nerve-supply be taken as the criterion of homology we are clearly led to an absurd position. The fact is that the innervation has probably undergone alteration in accordance with changes in the position, size, and relation to other organs of these ceratal processes. It may readily be supposed that, when such modifications have taken place as led to the appropriation of important organs like large blood-sinuses, huge hepatic cæca,

* Quart. Journ. Micr. Sci., xxxiii. (1892) pp. 587-623 (2 pls.).

† Comptes Rendus, cxv. (1892) p. 259.

‡ Tom. cit., pp. 127-9.

§ Quart. Journ. Micr. Sci., xxxiii. (1892) pp. 541-58 (3 pls.).

and cnidophorous sacs, nerves in the neighbourhood might be diverted from their original positions, and become drawn up into the cerata.

The authors point out that it is impossible to regard all these cerata as pallial outgrowths supplied by the pleural ganglia, and that it is possible that they may have been epipodial in origin, although some are now connected with pleural nerves.

Development of *Proneomenia*.*—M. G. Pruvot has made a study of the ova of *Proneomenia aglaopheniæ*, which are of some size, and surrounded by a supple and transparent shell. Segmentation is slightly unequal, and ends with the formation of a blastosphere with a small segmentation-cavity, which is by invagination converted into a gastrula with a large blastopore. The larva escapes covered with fine cilia. Like that of *Dendrosia* it divides into three segments; the cilia form a crown at the base of the median segment, and soon unite to form a long flagellum at the depressed apex of the cephalic segment. At the end of the sixth day the young has the form of a small, very contractile worm, completely covered with large discoid imbricated spicules, except along the median ventral line which is ciliated. These spicules only form a provisional investment, which is replaced later by long acicular spicules imbedded in a thick cuticle.

The primary endoblast does not correspond to the definite endoderm, but, by a special process, gives rise to all the tissues of the trunk of the adult. Its cells divide actively, and give rise to a superior endodermic mass which rests on a vault formed by a single layer of cells. These last increase and give rise to a layer folded in such a way as to form three diverticula, the lateral of which are mesenchymatous.

By the closing of the orifices of the lateral diverticula the invaginated vault is formed a second time into an uninterrupted cellular layer, but one which is exclusively ectodermic, and one which is altogether employed in the formation of the epidermis of the body. The periphery of the proctodæal orifice forms a caudal button which is the origin of the whole of the trunk of the future Neomenian. As this elongates it carries into its interior the lower portion of the endodermic mass.

The adult *Proneomenia* has no distinct head, although there are during development distinct signs of the formation of a true head, the appearance of which the author describes.

The facts detailed in the present communication and the similar phenomena seen as *Dendrosia banyulensis*, indicate that the development of the Neomenian differs considerably from that of the Mollusca. On the other hand the formation of the layers has a close resemblance to that of the Hirudinea, and may to a certain extent be compared with the Pilidium-stage of a Nemertean.

Arthropoda.

a. Insecta.

Larva of *Lagoa*.†—Prof. A. S. Packard has some notes on this Bombycine caterpillar, which has seven pairs of abdominal legs. This

* Comptes Rendus, cxiv. (1892) pp. 1211-4.

† Zool. Anzeig., xv. (1892) pp. 229-34 (2 figs.).

is a unique case, for no other Lepidopterous larva except the allied *Chrysopyga* is known to possess more than five pairs of abdominal legs. *Lagoa* appears to be the survivor of an ancient and very generalized type, and represents the polypodous ancestor of all Lepidoptera.

Another archaic feature in this Insect is the presence of seven pairs of permanently everted finger-shaped processes on the first seven abdominal segments; they occupy exactly the same position as the evaginable lateral glands of various Hemileucidæ. In a longitudinal section indications are seen of a deep narrow cavity; the glandular cells are modifications of the cells of the hypodermis. The author is inclined to regard these organs as the homologues of the prothoracic osmateria of the larvæ of Papilionidæ.

The Aphides of Coniferæ.*—Herr N. Cholodkovsky has made a special study of the genus *Lachnus*, whose species infest Conifers. He describes three species, *L. pini* L. on *Pinus silvestris*, *L. pineti* Fl. on *Pinus silvestris*, and a new form *L. farinosus* on *Picea excelsa*. In all these the males were winged, and distinguishable from the winged and unwinged females by the greater length of their antennæ (richly provided with olfactory grooves), by the strong development of the thorax, by the small and weakly developed abdomen, and by the shorter body. There seems to be no migration from the pines to other plants. A peculiar form which occurred on *Pinus cembra*, Cholodkovsky distinguishes as a variety of *L. pini*. From his researches it seems likely that some generations of a *Myzus* species, probably *M. oxyacanthæ* Koch, also occur on pines. Peculiar structures in the fatty body of the males of *Lachnus* seemed to the author at first to be bacteria, but were afterwards recognized as pigment-bodies.

African Œstridæ.†—Prof. F. Brauer gives a list of twenty-five species of Gastricolæ, Cuticolæ, and Cavicolæ known to be parasites of African Ungulates, and describes two new larval forms found by Dr. Holub. One of these—*Strobilæstrus antilopinus* g. et sp. n.—occurred in the skin of *Oreotragus saltatrix* and *Pediotragus campestris*; the other—*Dermatæstrus strepsicerontis* g. et sp. n.—in the skin of *Strepsiceros capensis*. The author appeals to travellers and others not merely to observe larval Œstridæ but to keep them and allow them to pupate so that the adult insects may be identified.

γ. Prototracheata.

Oviparity of Peripatus Leuckarti.‡—Dr. A. Denly brings forward fresh evidence in support of his statement that the larger species of *Peripatus* in Victoria sometimes, at any rate, lays eggs, and that these eggs are capable of undergoing development outside the body till perfect young are produced. It is true that a long time is required for the development of the eggs, but this is only to be expected when we consider the unusual length of time required for intra-uterine development in

* Zool. Anzeig., xv. (1892) pp. 66-70, 73-78 (1 fig.).

† SB. K. Bayer. Akad. Wiss., ci. (1892) pp. 4-16 (1 pl.).

‡ Ann. and Mag. Nat. Hist., x. (1892) pp. 136-43.

other species of *Peripatus*. Mr. Fletcher has denied the oviparity of *P. Leuckarti*, and the solution of the difficulty will probably be found in the distinctness of the larger Victorian species from that of New South Wales.

3. Arachnida.

Researches on the Arachnida.*—M. P. Gaubert finds that the cuticle of Arachnids is made up of two and not of three layers, as Schimkewitsch asserts. The inner is formed of several superposed lamellæ which are parallel and continuous over the whole extent of the skeleton. The rupture of the chitinous envelope at ecdysis depends on a purely mechanical action, due to the pressure caused by the increased volume of the animal. The elongated hypodermic cells found on the jaws are not, as Dahl thought, nervous, but are glandular. They secrete a viscous fluid which doubtless co-operates with the products of the maxillary glands and of the rostrum. The chitinogenous layer of the Phalangiidæ has modifications similar to those of the Araneidæ; some of the cells become glandular. A similar modification is seen in *Galeodes* and the Scorpions. The structure of the hairs is similar to that of the integument; they are formed by a series of concentric layers, the outermost of which may be ornamented. The tendons which are inserted into the integument are internal products of the chitinogenous layer. The glands, too, are modifications of the same layer. The poison-glands are enveloped by a layer of muscular fibres; they are not limited internally by the connective layer, as MacLeod states, and they have not the general sarcolemma described by Schimkewitsch.

The following may be regarded as sense-organs belonging to the appendages; the lyriform organs, the pectines of Scorpions, the coxal scales, and a new organ which the author has discovered at the extremities of the first pair of limbs and of the palps of the Galeodidæ. These last are formed of about fifty chitinous tubes, which put the interior of the limb in communication with the exterior. They are terminated internally by a hollow sphere, the diameter of which is three times that of the tube. The sphere is followed by another tube and then there comes a funnel, so that the whole has the form of a pendulum of a clock. All these tubes are imbedded in the chitinogenous layer which is here proportionately much thicker than it is in the rest of the body. Each funnel is provided with a nerve-fibre which is similar in structure to those found in the coxal scales.

The mouth-parts of Arachnids have been found to exhibit many differences in the different orders; the author has studied not only the muscles which move them, but the pharyngeal plates of Spiders and the pieces which altogether resemble them in structure, but which are found on the lateral appendages.

The musculature of the appendages is very uniform; the tendons increase in number with the shortness of the muscle. The last joint of the limbs has no muscles, and its movements are consequently passive in all except the Acarina. Although the limbs of Arachnids have generally the same number of joints it is usually only the first two that are homologous. At each cardiac systole the blood is driven into the

* Ann. Sci. Nat., xiii. (1892) pp. 31-184 (4 pls.).

limbs and makes them oscillate slightly; when, therefore, the limbs are extended and unsupported, simultaneous oscillations are produced, by means of which one may count the oscillations of the heart.

Coxal Gland of Scorpion.* — M. P. Marchal considers that this organ is of the same nature as the antennary gland and the shell-gland of Crustacea. The medullary substance contains two sets of lacunæ which are very distinct, though they have hitherto been confounded; some are glandular lacunæ, and the glandular epithelium which often fills the lumen is very similar to that which is found in the saccule of the antennary (green) gland of Crustacea. Others are blood-lacunæ; these are wide, and may be at once distinguished from the others by the fact that they are bounded by a proper membrane, which separates the glandular epithelium from the blood-fluid, and they are often filled by a coagulum which has a dotted appearance. The glandular lacunæ open into a wide central space which plays the same part as the central cavity of the ramified saccule of marine Decapod Crustacea, and is in direct communication with the long duct that forms the cortical substance. The author compares this with the arrangement found in the green gland of Crustacea. He regards the view of Lankester that the epithelium of the saccule is formed of differentiated connective tissue, and the cavity as part of the cœlom, isolated and adapted for excretion, as being confirmed by his investigations; for the glandular lacunæ of the medullary substance of the Scorpion may be considered as spaces hollowed out in the midst of a differentiated connective tissue.

The three sets of organs here regarded as of the same nature may be all looked upon as part of a metameric series.

Classification of Mites.† — Dr. Trouessart's essay on the classification of Acari is noticed by "C. M. W." He divides the sub-class Acaroidea into two orders, the Acarina, in which the abdomen is entirely united with the cephalothorax, and the Vermiformia, in which the abdomen is distinct from the cephalothorax and ringed, and in which there are no tracheæ. The Acarina are divided into three sub-orders, Prostigmata, Metastigmata, and Astigmata, in which the tracheæ, respectively, open on the anterior portion of the body, at the posterior part, or are absent. The first sub-order contains the four families of Trombidiidæ, Hydrachnidæ, Halacaridæ, and Bdellidæ; the second, the Gamasidæ, Ixodidæ, and Oribatidæ; and the third, the Sarcoptidæ. The Vermiformia are either octopod, with four pairs of feet, as the Demodicidæ, or tetrapod as the Phytoidæ.

Notes on Ixodidæ.‡ — Sig. A. Batelli publishes a preliminary account of some of his investigations on the structure and functions of Ixodidæ. The alimentary canal of *Ixodes*, with its buccal and suctorial organs and its digestive region, is first described. Digestion occurs especially, but not exclusively, in the lateral compartments. The hepatic cæca are at once storage regions and digestive. An account is given of

* Comptes Rendus, cxv. (1892) pp. 191-3.

† Amer. Natural., xxvi. (1892) pp. 712-3.

‡ Bull. Soc. Entomol. Ital., xxiii. (1892) pp. 218-35 (1 fig.); Monitore Zool. Ital., ii. (1891) pp. 78-84 and 98-104.

the changes in the digestive cells and of the modifications seen in the ingested blood. The excretion of the Malpighian tubules, at first liquid, takes the form of extra-cellular spherocrystals. As these were often found in the integument of *Ixodes* in a state of repletion, it seems as if the waste-products do not always follow the normal path of elimination. Batelli then describes the respiratory system. The stigmata are thoroughly integumentary in origin, and morphologically comparable to clusters of hairs. Of a dermatoptic sense in *Ixodes* no experimental evidence was to be had, but the author discusses the structure and very dubious physiological import of tarsal and other organs which seem as if they were sensory.

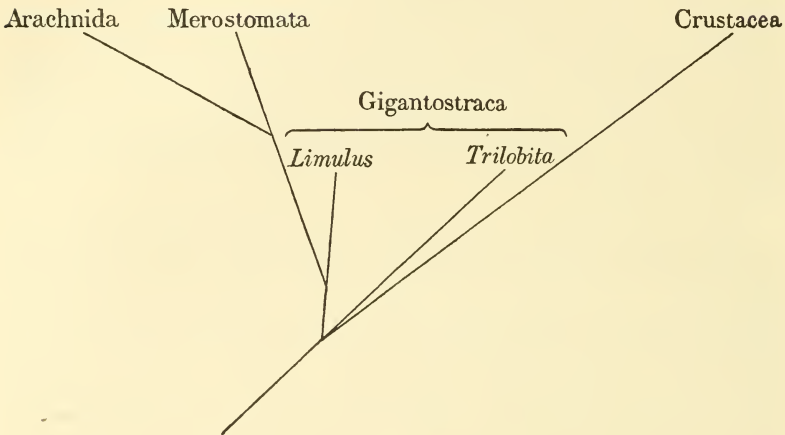
Development of *Limulus longispina*.*—Mr. Kamakichi Kishinouye has investigated the development of this King-Crab. The epiblast is developed in two ways; that of the ventral surface arises from the superficial layer of cells of the blastodermic thickening, while that of the dorsal surface is differentiated from the immediately underlying hypoblast cells by rapid multiplication. The mesoblast has three sources, one portion arises from the cells which form the lower part of the blastodermic thickening, and forms the mesoblast of the cephalothorax; the second portion arises from the primitive streak, and forms the mesoblast of the abdomen; the third portion arises from certain yolk-cells, and its fate is uncertain, but it probably becomes differentiated into blood-cells. The cephalothorax, which consists of the cephalic lobe and seven succeeding segments, forms the greater part of the egg, and becomes gradually flattened by the horizontal increase of the ventral plate. The abdomen is not developed till very late, and it is remarkable for having yolk in the middle portion only.

The lateral halves of the nervous system develop independently of each other; at one time the nervous system consists of peculiar groups of cells which resemble the ommatidia of the eye. They disappear when the ventral nerve-cord is divided into ganglia and begins to be separated from the epiblast. Two pairs of shallow cephalic invaginations appear, but disappear before the nervous system is separated from the epiblast. The brain of *Limulus* may be divided into four parts, the ganglion of the median eyes, the ganglion of the lateral, and the anterior and posterior portions of the brain proper. The lateral compound eye of *Limulus* is at first an epiblastic thickening with an invagination like a simple eye, and not a group of thickenings or invaginations. The lateral eyes are not thoracic but cephalic, and they shift their position gradually. The median eye of *Limulus* appears as a thickening anterior to the brain, and outside the semicircular cephalic groove, while that of the Arachnida appears as a thickening at the posterior end of the semicircular cephalic groove.

The coxal gland, which is probably a degenerated excretory organ, is not exactly homologous with that of the Spider. In the latter the gland opens at the base of the third appendage, and reaches to near the base of the sixth appendage, while in *Limulus* the gland opens at the base of the fifth appendage, and develops forwards to the base of the third.

* Journal Coll. Sci. Imp. Univ. Japan, v. (1892) pp. 53-100 (7 pls.).

With regard to the affinities of *Limulus* the author proposes this genealogical tree—



In the origin of the mesoblast, separation of the nerve-cord from the epiblast, formation of the heart, number and position of eyes, grooves in the brain, &c., *Limulus* approaches the Chordata more closely than it was thought to do, and the Arthropoda are, therefore, more nearly related to the Chordata than to the Vermes.

e. Crustacea.

Median Eye of Crustaceans.*—Prof. C. Claus discovered some years ago, in regard to the frontal eye of *Cypris*, that the nerve approached the visual cells from the outer side and that their ends were directed to the pigmented body; in short that the eye was an inverted cup-eye. He has extended this observation with reference to other Ostracoda, Branchiopoda, Cladocera, Argulidæ, Copepoda, Cirripedia, and Malacostraca. His general interpretation may be stated as follows in free translation.

The three optic cups which compose the median eye of Crustaceans, and are perhaps phylogenetically related to the eye-spots on the apical plate of Annelid larvæ, are, in contrast to what occurs in Insects, early removed from their ectodermic position, and are, like the brain, separated from the hypodermis and more or less dragged down. If we suppose that the three optic cups had originally a relation to one another and to the hypodermis like that which is observed in the three frontal eyes of Insects, not that a homology is asserted, we have to imagine that with the descent from the surface there was associated a convergent twisting towards one point. Thus we may explain the approximation of their convex surfaces, and the entrance of the nerves into the retina from the outer side. The pigment-forming cells, which lie peripherally to the stemma, and, comparable to an iris, around the mouth of the optic cup, would in the twisting or half-inversion be dragged down farthest, and would combine to form the two halves of each pigment sheath. On the other hand, the originally downward directed en-

* Arb. Zool. Inst. Univ. Wien (Claus), ix. (1891) pp. 225-66 (4 pls.).

trances of the nerves into the retina acquire a more lateral superficial position, thus resulting in the more or less inverted form of the cup-eye. In front of the retina groups of hypodermis cells may form lens structures. Finally the more or less depressed eye-cup, and, in cases of fusion, the tripartite eye-complex, acquires a mesodermic sheath which is continued directly into the neurilemma of the nerves to the retina.

Apodemes of Apus and Endophragmal System of Astacus.*—Mr. H. M. Bernard sets himself to show how *Apus*, with its powerful ventral longitudinal muscle-bands and its flexible skin, affords us a complete explanation of the endophragmal system of *Astacus*. In the latter the ventral muscle-bands, except those specialized for moving the tail, have almost entirely disappeared, and the deep folds of skin which the now vanished ventral muscles had called into existence, have become permanent calcified ridges, fastened together by sinewy connective tissue.

Correlated Variations in Crangon vulgaris.†—Prof. W. F. R. Weldon has attempted to apply Mr. F. Galton's method of finding a constant relation between the variations in size exhibited by one organ of an animal body and those occurring in other organs to the measurement of the correlation between four organs of the common shrimp. The organs measured were (1) the total carapace length, measured in a straight line; (2) the length of that portion of the carapace which lies behind the single gastric spine; (3) the length of the sixth abdominal tergum; and (4) the length of the telson. Five races of shrimps have been studied, and of the examples one thousand were females from Plymouth.

The author does not pretend that the results which he gives are sufficiently numerous or accurate to serve as a basis for generalization, but they do seem to suggest a very important conclusion. "For, if the values of the constant have really the degree of constancy which has been attributed to them, then by expressing the deviation of every organ examined from its average in terms of the probable error of that organ, the deviation of any one of these organs from its average can be shown to have a definite ratio to the associated deviation of each of the others, which is constant for all the races examined." As the organs examined and the samples of shrimps were, in the first instance, chosen by chance, any result which holds for all these organs through all these races may be reasonably expected to hold generally true of all organs through the whole species.

Prof. Weldon hopes that, by expressing the deviation of every organ from its average in Mr. Galton's system of units, a series of constants may be determined for any species of animal which will give a numerical measure of the average condition of any number of organs which is associated with a known condition of any one of them. "A large series of such specific constants would give an altogether new kind of knowledge of the physiological connection between the various organs of animals; while a study of those relations which remain constant through large groups of species would give an idea, attainable at present in no other way, of the functional correlations between various organs which

* Ann. and Mag. Nat. Hist, x. (1892) pp. 67-74 (1 pl.).

† Proc. Roy. Soc., li. (1892) pp. 2-21 (4 figs.).

has led to the establishment of the great sub-divisions of the Animal Kingdom."

Autotomy in Crabs.*—M. L. Frédéricq, who commenced the study of this subject nearly ten years since, has been engaged in making some fresh observations. He finds that autotomy, or the defensive reflex mutilation, of the limbs is produced in the Crab at the level of the groove which corresponds to the fusion of the basipodite with the ischiopodite. The surface of rupture is clean, for the vessels and nerve are the only soft organs which are torn through at this point. A special diaphragm, the obturator membrane, prevents the escape of blood; the nerve and the vessels cross this membrane at the level of a narrow orifice, which is situated excentrically. The non-deciduous portion of the second joint of the appendage, or basipodite, does not contain any muscular fibres; but it gives attachment at its proximal edge to the tendons of four muscles; the first joint, or coxopodite, affords attachment to two, and the fibres of all six are inserted into the epimera. Section of the muscles contained in the deciduous portion of the limb and that of five of the six attached to the non-deciduous part has no influence on autotomy, which is effected with the same facility after as before the operation. Section of the long extensor does prevent autotomy, and it may, therefore, be called the autotomist muscle.

Autotomy may be produced in any position of the limbs, except forced extension. For autotomy to be effected by the contraction of the autotomist muscle the distal deciduous portion of the limb must have a point of support, and the epimeral attachment must also be fixed; in some cases the weight of the animal is sufficient for this.

Formation of Germ-Layers in Isopoda.†—Dr. J. Playfair M'Murich finds that *Jaera albifrons* presents conditions favourable for a thorough study of a typical centrolecithal segmentation. The egg, when passed into the brood-pouch, is of a grass-green colour, and enclosed by a single envelope, the chorion; it is of an oval shape, and there is in the centre a stellate mass of protoplasm containing the nucleus, while a thin layer of peripheral protoplasm encloses the egg. In ovarian eggs which are about half-grown, a delicate protoplasmic network extends between the peripheral and central protoplasm. As a result of the early cleavages there is produced at one extremity of the egg a circle of four nuclei, and at the other a circle of three nuclei surrounding a fourth. The last is the ancestor of the endoderm cells.

A little later it may be seen that the egg is a syncytium, and it is probable that, so long as the nuclei are below the surface, a syncytium exists, but as they, with their protoplasm, begin to separate from the yolk, they become distinct.

At about the 128-stage there is a concentration of both mesoderm and ectoderm cells towards the ventral surface of the egg. Still later the mesoderm cells form a plug of cells which projects down a short distance into the yolk, forming the so-called blastodisc of the Crustacean egg. In some cases a semicircle of ectodermal cells may be seen surrounding the front margin of the blastodisc; each cell gives rise by division to a

* Arch. de Biol., xii. (1892) pp. 169-97 (6 figs.).

† Zool. Anzeig., xv. (1892) pp. 271-5 (2 figs.).

chain of cells which runs forward from it, similar to the chains produced by the teloblasts of *Lumbricus* or *Clepsine*. By this growth the teloblasts are pushed back over the mesoderm cells, and the mesoderm is forced below the surface of the egg. There is no invagination of the blastodisc whatever, but the ectoderm simply grows back over it. In the case of the endoderm cells there is actual immigration, the cells sinking down into the interior of the yolk and becoming the "vitellophags."

The cells of the mesoderm plug, soon after their overgrowth by the ectoderm, scatter, and the majority pass forwards to form the mesoderm of the head and anterior body region; others, which apparently take on a teloblastic function, are carried back along with the ectodermal teloblasts, and give rise to the mesoderm of the posterior part of the body.

Though the statements of the author are, in many respects, very divergent from those of previous writers on the embryology of Isopods, they may, he thinks, serve to bring into closer harmony the modes of formation of the germ-layers of those Crustacea, of which we possess an adequate account.

Spermatogenesis, Oogenesis, and Fertilization in Diaptomus.*—Prof. C. Ishikawa has made a study of the development of the reproductive elements in a Japanese species of *Diaptomus*. He finds that the primary sperm-cells correspond exactly with the primary egg-cells; each contains eight chromatic elements. In both sets of cells the eight chromosomes become constricted transversely so as to form eight dumb-bell-shaped bodies. After division has occurred two or three times, the resulting cells form the mother-cells of eggs or of spermatozoa. These, after growing considerably, begin to divide as before. In the egg this stage corresponds to the formation of the first polar body. Without any intervening resting stage of the nuclei there immediately follows another division, and there is a reduction in the original number of chromosomes (Weissmann's "Reduktionstheilung"). During the formation of the second polar body the sperm-cell enters the egg-cell. The nucleus of the sperm-cell is, ordinarily, at first rather small, and stains deeply and homogeneously, but differentiation soon sets in, and the four chromosomes become distinctly visible. The female pronucleus shows at first distinctly four elements, which soon grow longer, become much convoluted, and pass into a "skein" stage. After the formation of the equatorial plate the two nuclei unite; the number of chromatic elements in each of the copulating elements is now found to be eight, and in the first two segmentation spheres there are likewise eight chromosomes.

Nuclear Division in Cyclops.†—Dr. V. Häcker has studied the processes of nuclear division in the formation of the mesoderm and endoderm in *Cyclops*.

In *Cyclops brevicornis*, before the beginning of gastrulation, a single cell, appearing in the blastocœl, divides into a central and a peripheral portion by normal mitosis. The central cell (A) divides again, in heterotypic fashion, and forms the genital cells. From the peripheral portion (B) arise the two primary mesoderm cells. In the division of the cell ancestral to A and B the fine coil stage becomes a spirem, the

* Journal Coll. Sci. Imp. Univ. Japan, v. (1892) pp. 1-34 (1 pl.)

† Arch. f. Mikr. Anat., xxxix. (1892) pp. 556-81 (2 pls.).

chromatin threads are longitudinally split, transverse division and normal disposition of eight segments take place—all quite regularly. As division is accomplished the daughter-nucleus of cell A stains somewhat differently from that of cell B.

The second division of cell A is very different, as it occurs after the fashion which Flemming has called heterotypic. In each of the two derivatives of A there are only four chromatin loops. There is a "reduction-division." The two daughter-nuclei pass into the middle of the yolk and remain there in vesicular form throughout the whole of the embryonic development. They are the genital cells.

The B cell is intruded among the marginal cells of the future blastopore. It begins to divide by normal mitoses but with very broad dyaster-figures. Its derivatives form the primary mesoblasts. The formation of the gastrula is then described. Apart from the primary mesoblasts and the primary endoderm cells (corner-cells of the gastrula-mouth, pole-cells of the endoderm) mitoses never occur in this stage, either in ectoderm, or endoderm, or genital cells.

The gastrulation in *Cyclops* is the subject of special discussion. Of much importance is the early differentiation of a few primitive cells or pole-cells giving origin to endoderm, mesoderm, and genital rudiment. The endoderm arises by a succession of divisions in a few superficial pole-cells, which, with nuclear spindles directed obliquely to the radius of the ovum, give off internally successive crops of endoderm cells. These broaden out in a cup, but do not multiply internally until the midgut is definitely formed. Perhaps the form of gastrula may be directly connected with the early concentration of those elements which have the power of originating endoderm. Dr. Häcker suggests a possible line of evolution from multipolar immigration, through delamination and polar proliferation, to the concentrated type of endoderm-formation in *Cyclops*, viz. with a few pole-cells and a resulting cupola-like gastrula.

The fate of the second polar body is still obscure. It wanders into the centre of the embryo, and seems to come into relation with the derivative of the A cell. Perhaps there is some strange quasi-sexual attraction between them. Dr. Häcker concludes his paper with a further discussion of the heterotypic division of the A cell.

The Genus *Miracia*.*—Prof. C. Claus has studied this remarkable genus with especial reference to the structure of its eye. Dana gave a general description, and Brady described the appendages; Claus goes into greater detail. The cuticle is traversed by fine pores arranged in groups—the openings of unicellular skin-glands. Besides these there are canals from which very delicate, perhaps tactile, cuticular structures protrude. The anterior antennæ correspond accurately to those of Harpacticidæ; the posterior antennæ have a basal piece which Brady overlooked; the oral appendages most nearly resemble those of *Setella*, and the reduction of the palp-appendages is characteristic. Prof. Claus has various additions to make to Brady's account of the other appendages.

The gut is relatively wide, and bears internally projecting cells; the

* Arbeit. Zool. Inst. Univ. Wien (Claus), ix. (1891) pp. 267-84 (3 pls.).

nervous system exhibits a noteworthy concentration of the ventral chain, whose ganglia, as in Corycæidæ, are fused into a strand, covered with ganglionic cells, extending to the first free thoracic segment. An examination of the eye makes it likely that it is, in spite of its dorsal position, a median eye. This possibility is discussed at length.

The genital organs of the females are paired throughout. On the other hand, the male organs are, as in so many Harpactidæ, asymmetrically developed, sometimes on one side, sometimes on the other. On many grounds Claus maintains the near relationship of *Miracia* and *Setella*.

Body-cavity and Excretory Apparatus of Cirripedia.*—M. R. Koehler describes the general cavity of the body of Cirripedes as represented by lacunæ of connective tissue irregularly distributed between the wall of the body and the digestive tube. All these lacunæ, except two which are completely isolated, communicate with one another; the most considerable forms an important cavity placed at the point of union of the peduncle and the capitulum. All these lacunæ together represent the general cavity, but there are two which differ in certain important characters; they have a proper wall with an endothelial investment, they do not communicate with the others, and they are more constant in character. They are situated in the cephalic region, on each side of the digestive tube, and they extend towards the ventral side, where they are separated by a wide connective septum. In the pharyngeal region they send off, towards the lower lip, a prolongation which opens to the exterior by a fine canal. This communication appears to be general in all the Cirripedia.

The excretory organs have been incompletely figured by Messrs. Hoek and Nussbaum, the two authors who have most recently occupied themselves with these animals. The organs in question are paired, and form on each side of the body a sort of sac which is placed between the integuments, and the two large spaces described above. They vary much in different genera. In the Balanidæ and *Anelasma* they are sacs with a simple cavity, but in *Scalpellum* and *Pollicipes* they are divided into several compartments, while in *Lepas* and *Conchoderma* they are divided into a large number of compartments, owing to the formation of anastomosing septa.

In *Pollicipes cornucopiæ* the apparatus is largely developed, and the different parts of the renal sacs give off numerous prolongations which traverse the interposed layers of connective tissue and reach the wall of the general cavity; there, however, they have not been seen to open. Exchange appears to be effected by endosmosis. In some forms the elongated and tortuous lacunæ ramify on the walls of the sacs, and so multiply the surfaces of contacts.

In *Conchoderma* the author has discovered a communication of the organs of excretion with the exterior which he has not noticed elsewhere. The histological characters indicate that these organs are rather kidneys where solid products are amassed than eliminating organs with a wide communication to the exterior. Further details are promised.

New Cirripedia.†—Dr. C. W. S. Aurivillius describes a number of new species from various localities, among which are thirteen forms

* Comptes Rendus, cxiv. (1892) pp. 1214-7.

† Ofv. K. Vet. Akad. Förh., xlix. (1892) pp. 123-34.

of *Scalpellum*, and a representative—*Lithoglyptes indicus*—of a new family, the Lithoglyptidæ, of Abdominalia. It has four pairs of biramose cirri at the hinder end; and the caudal appendices have three or four joints.

Belisarius Vigneri.*—Under this name M. Maupas describes a new freshwater Copepod from Algeria. It is one of the Harpactidæ, but is distinguished from all known members of the family by having the first thoracic segment distinct and not fused with the head. A short account is given of the development; there are six naupliar and six cyclopoid stages: in the former there is an antennary gland, which is, in the latter, replaced by the test-gland. This last has at its internal end a large funnel in which a vibratory apparatus oscillates rapidly; this organ is a new and powerful argument in favour of the view that the test-gland is the homologue of the segmental organs of Annelids.

British Schizopoda.†—The Rev. Canon A. M. Norman gives a revision of the species of Lophogastridæ and Euphausiidæ known to live in the British Seas. This is particularly useful from the fact that there is no account in any English work of these oceanic Crustaceans, which are either surface swimmers or live in deep water at some distance from land. Five genera and eight species are enumerated.

British Mysidæ.‡—The Rev. Dr. A. M. Norman completes his account of the British Schizopoda by giving descriptions of the British species of Mysidæ. In Bell's 'British Stalk-Eyed Crustacea' only six species of this family were described; in the present paper an account is given of thirty-three species, belonging to five sub-families. More will probably be found when the British deep-water fauna is properly investigated.

Heliotropism of Nauplii.§—M. C. Viguier has investigated the heliotropism of Nauplii, after studying the work of Messrs. Groom and Loeb. The frequent and irregular change in direction exhibited by the larva of *Balanus perforatus*, and the indifference to light of those of *Lepas pectinata* make it difficult to believe that the vertical excursions of Nauplii are solely due to heliotropic causes. He inclines to the view of Chun that temperature is an important factor.

Vermes.

a. Annelida.

Polychæta of East Spitzbergen.||—Dr. E. von Marenzeller reports that fifty-eight species of Polychæta were collected by the Bremen Expedition to East Spitzbergen, and these (*Spirorbis* not being counted) were represented by about 750 specimens. Notes as to details of many of the species are given, and there are valuable synonymical lists of the kind which we are in the habit of expecting from the learned author.

* Comptes Rendus, cxv. (1892) pp. 135-7.

† Ann. and Mag. Nat. Hist., ix. (1892) pp. 454-64.

‡ Op. cit., x. (1892) pp. 143-66; 242-63 (2 pls.).

§ Comptes Rendus, cxiv. (1892) pp. 1489-92.

|| Zool. J.B., vi. (1892) pp. 397-434 (1 pl.).

The Chloræmidæ.*—Prof. W. A. Haswell's observations on this family commence with an account of *Coppingeria longisetosa* g. et sp. n., found in Port Molle and off Darnley Island, and of two new species of *Stylarioides*, *S. cinctus* and *S. Horstii*, both found in Port Jackson. The integumentary papillæ are considered to be sensory in function. The various genera of the family exhibit a considerable amount of difference in the arrangement of the blood-vessels, but the general features appear to be as follows:—There is a circumintestinal sinus or plexus of sinuses in the wall of the alimentary canal; this terminates anteriorly at the cardiac end of the stomach, and from it there runs forwards a large median dorsal vessel or heart, which is subject to regular peristaltic contractions, by which the blood is driven from behind forwards. In the peristomial region this vessel divides into two main afferent branchial vessels, each of which divides to give rise to the corresponding tentacular and branchial branches. In *Coppingeria* the excretory glands are of large size and deeply lobed; they are prolonged for some distance backwards in the form of two comparatively narrow tubes. The glands are lined with an epithelium of large irregularly-shaped cells, with vacuolated protoplasm which contains numerous rounded granules of various sizes, some of which are stained deeply by hæmatoxylin. *Coppingeria* has two pairs of eyes which are situated on a lobe, which is a process from the præstomium between the bases of the branchia. A group of nerve-cells, which forms an optic ganglion, projects into the interior of the oculiferous lobe; this ganglion is really a lobe of the brain, with which it is in immediate connection, so that there are no optic nerves. In *Siphonostomum affine* the pigment forms an almost complete capsule, with only a small opening. The tentacles of *Coppingeria* are marked by a deep longitudinal groove on the ventral surface. They are hollow and the cavity is divided by a dorsoventral longitudinal septum, in which runs the main blood-vessel. The cuticle is very thin, and the epidermis has the cells more elongated than those in the body; many or all bear cilia. It is clear that we have here to do with an epithelium which is specialized not only in the direction of bearing cilia for driving food towards the mouth, but also in that of possessing numerous sensory cells, connected either with a specially developed tactile sense or with a sense of taste or smell.

Development of *Acanthodrilus multiporus*.†—Mr. F. E. Beddard finds that the nephridia of the youngest embryos of this earthworm are paired tubes opening to the exterior near the lateral setæ, and each is provided with a funnel which opens at the segment in front. They are found in all the segments of the body, but the first two segments have only one pair each; these open to the exterior at the commencement of the stomodæum. Later on, the second pair of nephridia, and, afterwards, one or two other pairs become connected with the first pair, and constitute the "mucous gland." The funnels of the nephridia, except those of segment xi.-xiv., become rudimentary, and numerous secondary external apertures are formed. The anal nephridia are a comparatively late formation; they appear to open into the mesenteron and not into the proctodæum.

* Proc. Linn. Soc. N.S.W., vi. (1892) pp. 329-56.

† Quart. Journ. Micr. Sci., xxxiii. (1892) pp. 497-540 (2 pls.).

There are four pairs of gonads which, up to a certain point, develop equally; later on, the gonad of segment xii. degenerates. Four pairs of genital ducts are developed from nephridial funnels and a short section of the succeeding tube. The young embryo is provided with an unpaired sense-organ which consists of a few large embryonic cells, and is placed on one side of the stomodæal aperture. In the epidermis of the very advanced embryo there are peculiar cells which may possibly be sense-organs.

Central Nervous System of Earthworm.*—M. P. Cerfontaine has investigated the structure of the so-called giant-fibres of Leydig, which have been the cause of so much discussion. He comes to the conclusion that they are nervous in nature, and that they are quite special nerve-fibres which are due to the union of the prolonged cylinder-axes of several cells. As the median giant-fibre arises anteriorly and is directed backwards, its nerve-current is antero-posterior. The direction of development, and therefore of the nerve-current, is postero-anterior in the lateral fibres. On their course the giant-fibres give rise, in each ganglion, to ramifications which put them into relation either with other elements of the chain or with the periphery. These fibres ought to be considered as very complex nervous formations, which have to establish connections between the different parts of the nervous system. In fact the author thinks that it is the possession of these fibres which allows of the simultaneous production of muscular contractions in all parts of the body of the earthworm.

By applying the method of Ehrlich it was found that the number of cells which enter into the constitution of one ganglion is larger than can be shown in a drawing, and the same is true of the columns of nerve-fibres.

A Double-headed Earthworm.†—The Rev. H. Friend has a brief note on a species of *Allolobophora longa* Ude, in which the head is double; the second head appears to consist of two segments only.

New Genus of Oligochæta.‡—Mr. F. E. Beddard describes under the name of *Gordiodrilus* a new genus of Oligochæta, which he places near to *Ocnerodrilus*. Four of the new species of the genus are from West Africa, and the fifth from the island of Dominica. So far as the atrial pores are double and the opening of the vasa deferentia independent this new form resembles *Acanthodrilus*, but it, with *Ocnerodrilus* and *Moniligaster*, alone amongst the terricolous forms, agrees with the aquatic genera in having the lining of the atrium formed by a single row of cells. For the present the new genus is placed in the family Ocnerodrilidæ.

Dissemination of Hirudinea by Palmipedes.§—M. J. de Guerne brings together several instances which show that leeches may be carried from place to place by wild ducks and other Palmipedes. One leech,

* Bull. Acad. Roy. de Belgique, 1892, pp. 742-52 (2 pls.).

† Science-Gossip, 1892, p. 161 (2 figs.).

‡ Ann. and Mag. Nat. Hist., x. (1892) pp. 74-97 (2 pls.).

§ Comptes Rendus Soc. Biol., 30 Jan., 1892. See Ann. and Mag. Nat. Hist., x. (1892) pp. 117-20.

which was for a long time under observation, was found to be able to survive very considerable variations in temperature.

Gephyrea of the 'Prinz Adalbert.'*—Dr. A. Collin has a report on the four Gephyrea, two of which are new, collected during the voyage of the German ship 'Prince Adalbert. *Phascolosoma sanderi*, from an unknown locality, has some resemblances to Ray Lankester's *Golfingia macintoshi*; *Dendrostoma peruvianum*, from Callao, is closely allied to those species of *Phascolosoma* in which there are two retractor muscles and no hooks.

β. Nematelminthes.

The Genus Dispharagus.†—Prof. M. Stossich corroborates the opinion of Dujardin and Molin that the genus *Dispharagus* is quite distinct from *Filaria* or *Spiroptera*. The constant presence of two triangular lips, the cutaneous, possibly tactile, cords which extend backwards from the anterior ends, the two unequal cirri, and the four pre-anal papillæ are distinctive. These parasites are found in the gullet and stomach of birds. The known species number 35, of which 9 are imperfectly known. The remaining 26 are divided into two sets, according to the presence or absence of spines.

Early Stage in Development of an Oxyuris.‡—M. L. Jammes has been able to study the development of an *Oxyuris* from the cæcum of *Testudo nemoralis*. The egg is enclosed in an oval test, which the embryo does not leave until nearly adult; segmentation is total and equal; the regular morula as it grows becomes more and more elongated, and when the change in form begins two or four cells at one end are conspicuous by their size; these, however, have no special function, but appear to be merely elements which have been retarded in their segmentation. In the planula-stage there is a superficial layer of cubical cells, and a compact subjacent cellular mass, which represents the mesendoderm.

The most important point in the embryogeny is the division of the mesendoderm into a definite mesoderm and endoderm; this is effected by a circular cleavage, which generally begins in the middle of the body and extends to either end. The definite endoderm is, at first, formed of a cylinder, circular in section, but a capillary lumen is not slow in appearing to begin the formation of the digestive cavity. The definite mesoderm is represented by a single layer of cells adhering to the ectoderm; it is, however, double in the middle part of the body, or in the region where the gonads are developed. It will be noticed that this history contains no account of the existence of a true Gastrula-stage, and so far differs from that of most Nematodes.

Nematode from the Chipping Sparrow.§—Dr. E. Linton describes *Trichosoma rubrum* sp. n. from the thoracic cavity of *Spizilla socialis*; it has a diameter proportionally many times greater than that of any recorded species of the genus; as the median diameter is 0.90 mm. and the length 25 mm., the body is by no means hair-like.

* Arch. f. Naturg., lviii. (1892) pp. 177-82 (1 pl.).

† Bull. Soc. Adr. Sci. Nat. Trieste, xiii. (1891) pp. 81-108 (3 pls.).

‡ Comptes Rendus, cxiv. (1892) pp. 1555-7.

§ Amer. Natural., xxvi. (1892) pp. 705-7 (5 figs.).

Nectonema agile.*—Mr. H. B. Ward gives a detailed account of this pelagic worm, the systematic position of which is a matter of some difficulty. He himself thinks that, though the points of difference between it and *Gordius* are more numerous than those of resemblance, the latter are more general and important. The characters which separate the Gordiidae from the rest of the Nematoda are possessed by *Nectonema*—the absence of lateral lines, the existence of one principal nerve-cord (ventral), the dorsal position and terminal openings of the genital organs. The points of difference are largely those which separate the various families of Nematodes from one another, such as the structure of the muscles, and the characters of the ducts and external sexual organs.

Mr. Ward thinks that the greater reduction of the alimentary canal and of the nervous system in *Gordius* is evidence of its being the more degenerate form. The possession by *Nectonema* of rows of bristles is certainly to be attributed to its free life and more active habits. Further and more definite decisions as to the position of *Nectonema* may be delayed till its life-history has been investigated. It is probable that till sexual maturity *Nectonema* is parasitic in some fish or crustacean, and the absence of eye-spots or sense-organs, the diminutive size of the alimentary tract as compared with that of the animal, and the absence of any functional anus are all characters that point to the parasitic nature of the worm. When free it appears to come to the surface at night only.

Structure of Echinorhynchus.†—Dr. J. Kaiser continues his account of the minute structure of this type. He is first concerned with the musculature of the proboscis—its structure and development. He describes this not only for the musculature as a whole, but for each set of muscles. Passing to the nervous system he gives first the usual history of investigation, then his own observations. The central nervous system consists of a cephalic ganglion of considerable size, lying between the retractors of the proboscis at a variable distance from the posterior end of the proboscis sheath. In *Echinorhynchus gigas* the ganglion gives origin to not less than eight nerve-strands, but in other species there are fewer. The minute structure of ganglion and nerves is analysed with great carefulness. Embryological investigations confirmed Herr Kaiser's conviction that both ganglion and nerves had an ectodermic origin; the same is true of the special genital ganglia. The present instalment of this monograph breaks off in the middle of the chapter on the male genital organs.

Helminthological Notes.‡—Prof. M. Stossich continues his description of a collection of Venetian parasites made by Dr. A. Conte de Ninni. Among the forms noted are *Cucullanus Dumerilii*, *Monostomum trigonocephalum*, *Distomum Raynerianum*, *Echinorhynchus Ninnii*, *Tænia brachycephala*, *Amphicotype typica*.

* Bull. Mus. Comp. Zool., xxiii. (1892) pp. 135-89 (8 pls.).

† Bibliotheka Zool., Heft 7 (1892) pp. 113-36, and Heft 8, pp. 1-32 (1 pl.).

‡ Boll. Soc. Adr. Sci. Nat. Trieste, xiii. (1891) pp. 109-16 (1 pl.).

γ. Platyhelminthes.

Freshwater Nemerteans.*—M. J. de Guerne has been impelled by Dr. du Plessis' "very surprising discovery" of Nemerteans in the Lake of Geneva to draw up a short account of the various species recorded as inhabiting fresh water. It is certain that one or more species have gradually become definitely accustomed to fresh water. Nemerteans appear to have quite a special plasticity for adapting themselves to the most varied conditions of existence.

Original Habitat of Bipalium Kewense.†—Prof. F. Jeffrey Bell called attention to the fact that this worm was found by him in a collection made at Tongatabu by Mr. R. B. Lecfe. As it had also been found at Samoa, and exchanges of plants had been made by Kew Gardens with Fiji, it is probable that this group of islands is the original home of the species. On the other hand, Prof. W. Baldwin Spencer ‡ found it in Queensland during his recent visit there in search of *Ceratodus*.

Genital Apparatus of Tristomidæ.§—Dr. G. Saint-Remy has investigated the structure of the genital apparatus in *Tristomum molæ*, *Phyllonella soleæ*, *Pseudocotyle squatinæ*, *Microbothrium apiculatum*, and *Udonella pollachii*. On the whole, these forms exhibit great similarity. The male apparatus always consists of the same organs, but they vary in the extent to which they are developed. The number of testicles may be one (*Microbothrium*, *Udonella*), two, or many; they are always situated in the middle of the body; they are always bounded by a connective envelope, though it is true that it is very delicate, and only slightly differentiated from the surrounding tissue. The efferent canal is always long and sinuous, and is in some cases provided with a seminal vesicle. In some genera there are special glands which secrete a fluid which is mixed with the spermatozoa. The ejaculatory apparatus always consists of a vesicula ejaculatrix under the influence of more or less powerful muscles, and of a canal which is enclosed in a penis, except in *Udonella*, where the copulatory organ is absent. The erectile part of the penis is formed of an elongated body which is almost completely muscular; it is lodged in a deep invagination of the ventral wall of the body. In all the genera studied, except *Tristomum*, there is a genital cloaca.

The female organs are likewise constructed on a general plan, and it is only in the copulatory apparatus that any important modifications are to be found. The "germigenous" organ is always single, and rarely multilobate; the germiduct varies in character on its course to the ootyp; the muscular apparatus described by Vogt as drawing out the genital products is found only in *Phyllonella*; in the other genera the movements are due to the accumulation of products and to the contractions of the body. The shell-glands which secrete the substance of the test are always unicellular, and are so elongated and filiform that it would be difficult to recognize them for what they are, but for one's knowledge of them in other types. They are the bodies which Vogt took for the muscular fibres of his "orifice dégluteur."

* CR. Soc. de Biol., April 1892. See Ann. and Mag. Nat. Hist., x. (1892) pp. 197-200.

† Proc. Zool. Soc. Lond., 1892, p. 258.

‡ Nature, xlvi. (1892) p. 306.

§ Arch. de Biol., xii. (1892) pp. 1-55 (2 pls.).

The author retains the name ootyp for the organ in which the germ is enveloped by yolk-globules and enclosed in a solid shell. It varies in form and structure. From it there passes off a wide canal which becomes united with the pouch of the penis to form the genital cloaca; this is the oviduct. It is very short in Monocotylids, where it serves only for the expulsion of the eggs, but in the others it is very long and capable of dilatation, so as to preserve the eggs for some time; hence the name of uterus, which some authors have given it.

The vitellogenous apparatus is always well developed, and situated in the lateral parts of the body; its follicles are bounded by an extremely delicate membrane, and have no epithelial layer. The small ducts given off from the follicles unite into two long longitudinal canals, capable of being enlarged on necessity. In no form of the group has the author found any duct analogous to the vitello-intestinal canal which has been described in a number of Polystomidæ. In all, however, there is a seminal reservoir or receptacle in which the spermatozoa are stored before being used. It is always a pouch of some size which communicates with the female ducts by an extremely narrow canal. A vagina is found in some forms only, and it may be single or double. The double form is probably the more primitive, and the single one is due to the disappearance of either the right or the left member of the pair.

Water-vascular System of *Mesostomum truncatum*.* — Dr. W. Voigt finds that this Turbellarian is more capable than most, of resisting the pressure of the cover-glass, and he has been able to follow out the whole course of its water-vascular system. The two efferent orifices do not open into the outermost portion of the pharyngeal pouch, but further back, and freely on the ventral surface of the worm. A line of connection between the two orifices passes about midway between the mouth and genital orifice. There is no terminal piece running transversely through the body, but, as in *Derostomum unipunctatum*, there is a vascular trunk on either side, which passes forwards with looped coils, bends round just behind the eyes, and, getting gradually narrower, may be followed to the hinder end of the body. A few ciliated funnels were observed in the first and last thirds of the body. The author proposes to form a new genus for this worm on account of the abnormal position of the excretory orifices, which he calls *Olisthanella*.

Monostomata from Intestine of *Chelone viridis*.† — Herr E. Walter records from this tortoise *Amphistomum scleroporium* Crepl, *Monostomum trigonocephalum* Rud., *M. reticulare* Van Ben., and *M. proteus* Brandes. He has studied in the last of these the mode of termination of the dorso-ventral musculature. It has hitherto been supposed that the muscles of the parenchyme were inserted on the inner surface of the limiting membrane; he finds, however, that, in *M. proteus*, they traverse the whole of the membrane; this last is perforated by pore-caliculi, through which diverging fibrils of muscle pass. Similar relations have also been observed in other Trematodes.

M. reticulare is to be found in such different forms that, were intermediate stages wanting, it would be easy to make a new species. In

* Zool. Anzeig., xv. (1892) pp. 247 and 8.

† Tom. cit., pp. 248-50.

quite young stages there are two rows of proportionately large oval or rounded vesicles, about fifty in number. In a succeeding stage there are only twenty-four, and in sexually mature individuals there are but scattered remnants left. In like manner the mature individual has not the two long pouches which are found at the base of the sucker in the young. The same species has not a cirrus-pouch, in the exact meaning of that term; there is a muscular tube which appears to consist merely of muscular fibres.

In all three species of *Monostomum* the author has discovered an organ which has not, apparently, been yet described. It lies round the excretory pore, and appears to be a part of the excretory apparatus. It forms large saccular diverticula on the terminal part of the efferent duct which lies in front of the excretory pore. Further details are promised.

The large American Distomum.*—Prof. R. Leuckart shows that *Fasciola carnosa* of Hassall † is not confined to America. He thinks that *Distomum magnum*, as Bassi called it, was brought to Europe by the Wapiti deer.

Distomidæ in Birds.‡—Prof. M. Stossich has made a monographic study of these parasites. He describes no less than sixty-four species of *Polyorchis*, *Cephalogonimus*, *Cladocælium*, *Crossodera*, *Distomum*, *Echinostomum*, *Mesogonimus*, and *Agamodistomum*, and notes fifty-seven doubtful species of *Distomum*. A useful index of birds is given with the Distomidæ known to occur as parasites in the several species.

New Temnocephala.§—M. A. Vayssière's researches on *Temnocephala madagascariensis*, a new species of parasite on the body of *Astacoides madagascariensis*, have led him to prepare a fresh diagnosis of the genus to which it belongs; he accepts Semper's view that the worm is a Trematod and not a Lecch.

Spermatogenesis of Trematoda.||—Dr. F. S. Monticelli has studied this in *Distomum megastomum* and many other forms. In the young the testicles are uniformly filled with spermatogonia which are at first directly transformed into spermatocytes, while subsequently the latter originate by the indirect division of the spermatogonia. In older testicles the spermatocytes divide by ordinary karyokinesis and form spermatocytes of the second order. These adhere in pairs, the separation after division being incomplete, and each divides so that groups of four result, each of which again divides. Thus, eventually, there results a ball of spermatocytes, a sperm-morula, without a distinct cytophore. Finally, the spermatocytes composing the spermato-morula are differentiated into spermatides or young spermatozoa. Dr. Monticelli describes this last modification, which results for instance in the chromatin of the nucleus forming the head of the spermatozoon, but it does not differ essentially from what is true in many other organisms. Finally the

* Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 797-9.

† See this Journal, *ante*, p. 41.

‡ Boll. Soc. Adr. Sci. Nat. Trieste, xiii. (1892) pp. 143-96.

§ Comptes Rendus, cxv. (1892) pp. 64 and 5.

|| Boll. Soc. Nat. Nap., v. (1891) pp. 148-50.

author notes that the spermatogenesis of Cestodes is, according to his researches, virtually the same as that above described for Trematodes.

Vitelline Nucleus in Ova of Trematoda.*—Dr. F. S. Monticelli has studied this structure in the ova of *Distomum veliporum* and *D. Richiardi*. He does not agree with Balbiani and Sabatier, but rather with Schütz, Stuhlmann, and von Jhering, concluding that the vitelline nucleus has no intimate connection with the germinal vesicle, has no rôle in the process of fertilization, but is rather a cytoplasmic product, a nutritive differentiation, probably acting as a centre in the formation of yolk.

Classification of Cestoda.†—Dr. F. S. Monticelli has some systematic notes on the genus *Bothrimonus* Duvernoy, of which he recognizes three species, whose synonymy is somewhat intricate, viz. *B. sturionis* Duvernoy from *Acipenser*, *B. Olriki* Krabbe from *Salmo carpio*, and *B. Rudolphi* Monticelli from the sole.

But he has in addition some discussion of the general classification of Cestodes, and proposes the following arrangement.

1. Sub-order. Atomiosoma.
 - Fam. 1. Diplocotylidæ.
 - Fam. 2. Tricuspindariidæ.
2. Sub-order. Tomiosoma.
 - Tribe I. Atrypanorhyncha.
 - Sub-tribe (1) Monossichionia.
 - Fam. 3. Cyat[h]bothriidæ.
 - Sub-tribe (2) Dissichionia.
 - Fam. 4. Pseudobothriidæ.
 - Fam. 5. Dibothriidæ.
 - Sub-tribe (3) Tetrassichionia.
 - Fam. 6. Tetrabothriidæ.
 - Fam. 7. Tetracotylidæ.
 - Tribe II. Trypanorhyncha.
 - Fam. 8. Tetrarhynchidæ.

Cestodaria.‡—Dr. F. S. Monticelli announces a monograph on the Cestodaria—a title under which he includes the simple, unjointed, monogenetic Cestodes—*Gyrocotyle* (= *Amphiptyches*), *Amphilina*, *Caryophyllæus*, and *Archigetes*. In the present paper he gives a description of two forms, of which hitherto but little has been known, viz. *Amphilina liguloidea* (Diesing) = *Monostomum liguloideum* Diesing, and *Caryophyllæus tuba* Wagener (nec Siebold), = *Ligula* (Wagener), *Monobothrium* (Diesing) *tuba*.

New Cestodes.§—Dr. F. S. Monticelli describes several Cestode parasites of *Lamna cornubica* and *Delphinus delphis*. Among those which are found in the fish is *Ceratobothrium xanthocephalum* g. et sp. n. In this member of the Tetrabothriidæ the head is large and distinct; the suckers are large, complete, and sessile, with a large and prominent

* Estr. Boll. Soc. Nat. Napoli, vi. (1892) 3 pp.

† Monitore Zool. Ital., iii. (1892) pp. 100-105.

‡ Estr. Atti R. Accad. Sci. Napoli, v. (1892) 11 pp. (4 figs.).

§ Bull. Mus. Zool. Torino, vii. (1892) No. 127, pp. 1-9 (1 pl.).

accessory sucker which bears two horn-like spurs on its posterior margin. The neck is of median length. The genital apertures are marginal and irregularly alternating. From the dolphin Monticelli describes one of the Tetracotylidæ which Kreffit recognized (*Tænia Forsteri*), but which is referable to a new genus, *Prostheocotyle*. The body is anteriorly lanceolate; the head is small, quadrangular, quite distinct from the neck, with four tubercles at the four anterior angles; the suckers are large and strong; and each is furnished antero-laterally with an elongated appendage; the neck is short, and not very distinct from the body; the segments are crowded, imbricate, and much broader than they are long; the genital apertures are marginal and unilateral.

Cercaria Clausii.*—Dr. Th. Pintner gives some description of this remarkable form of *Cercaria*, named as above by Monticelli. It occurs in strange groups, the members of which have their tails coiled together after the fashion of a "Rattenkönig." The intermediate host was the Prosobranch *Trivia europæa* Ad. (*coccinella* Lam.). In confinement this Mollusc liberated about thirty of the *Cercaria* colonies in a day. These swam about for two days or so, sank to the bottom, and sooner or later lost their tails and died. Dr. Pintner notes that the members of a colony do not free themselves voluntarily, and that the movements of the colony are very arbitrary. Claus suggested that Medusæ were perhaps final hosts of these *Cercariæ*; but this remains quite uncertain.

The number in a colony varied from 10-20; the length of each *Cercaria*, apart from its tail, was from .2-27 mm. The predominant reticulate pigmentation of body and tail is bright yellow, and there are also little black corpuscles in the body. Anteriorly lies a spherical sucker with a narrow stalk, probably the œsophagus, as Monticelli believed. The ventral sucker lies towards the posterior end. The tail consists of three parts, a large sac-like region with stiff hairs, a thin tentacle-like prolongation, and a terminal knob. In regard to all this Dr. Pintner notes such details as he was able to observe, but it is to be hoped that more will be soon heard of the "Rattenkönig-Cercarie."

Multilocular Echinococcus and its Tænia.†—Dr. Mangold reports three cases of multilocular *Echinococcus* which have been observed during the past four years at Tübingen. In all three cases the parasite had settled in the liver. The *Echinococcus* occurs in man after swallowing the ova of *Tænia echinococcus*, its embryo being set free by the action of the gastric juice upon the shell. Whether the embryo arrives at its final destination by active or passive migration is still doubtful. At any rate, its path is along veins, as may be gathered from its frequent occurrence in the liver; herein it may assume the hydatid or alveolar form. The multilocular *Echinococcus* adopts the latter shape, developing in spaces in the hepatic substance, and filling these out, imparts to the liver a porous spongy appearance. The set of vessels it pursues is variable, and hence the presence or absence of certain symptoms (ascites, jaundice).

The unilocular *Echinococcus* is spread over the whole earth, while

* Arb. Zool. Inst. Univ. Wien (Claus) ix. (1891) pp. 285-94 (1 pl.).

† Berliner Klin. Wochenschr., 1892, Nos. 2 and 3. See Centralbl. f. Bakteriolog. u. Parasitenk., xi. (1892) pp. 738-9.

the distribution area of the multilocular form is more restricted, being confined to Bavaria, Württemberg, Switzerland, and Austria. A satisfactory explanation of the geographical distribution of the multilocular hydatid can only be given by assuming that it is produced by a different *Cysticercus* from the unilocular, a view which Leuckart negatives, while Vogler, who is supported by the author, calls attention to the difference in the hooklets, and shows that these are longer than in the unilocular hydatid.

The author made experiments with multilocular hydatids by feeding two dogs with liver infested with the parasite. One dog was killed fifty days after feeding, and three specimens of *Tænia echinococcus* were found in the small intestine. The intestine of the other dog also contained a *Tænia echinococcus*. A pig twelve weeks old was then fed with the gut of one of these dogs, and four months afterwards its liver was found to contain a multilocular hydatid.

δ. Incertæ Sedis.

Frenzel's Mesozoon Salinella.* — Prof. S. Apáthy considers the biological importance of this interesting organism. It appears to him to fill the gap between *Volvox* and *Trichoplax*. Of a gulf between Protozoa and Metazoa it is no longer fair to speak, least of all so pessimistically as does Frenzel. Apáthy discusses at length the characters of *Salinella*, interpreting them more hopefully than the discoverer does, and comes to the conclusion that a gap in our knowledge as to the origin of Metazoa from Protozoa has been most satisfactorily filled.

Echinodermata.

Crinoids and Echinoids of the Norwegian North Sea Expedition.†—Dr. D. C. Danielssen gives a very detailed description of *Bathycrinus Carpenteri*, for which it is now found unnecessary to form the distinct genus *Ilycrinus*. There is a description of *Echinus Alexandri* D. & K., some notes on *E. norvegicus*, and station lists giving the occurrence of twelve other species of Echinoids.

Classification of Ophiuroids.‡—Prof. F. Jeffrey Bell has been led by a study of a remarkable Ophiuroid with coiling arms, which he calls *Ophioteropsis elegans*, to propose some modifications in the classification of the Brittlestars. The articulating surface of the arm-ossicles of the new genus are extremely generalized; there is neither the definite saddle-shape face of the Astrophytidae, nor the possession of processes and pits as seen in *Ophiura* or *Ophiothrix*. For such forms as have the ambulacral ossicles articulating by means of a more or less simple ball-and-socket joint he proposes the name of Streptophiuræ; the Astrophyuræ or Cladophiuræ are those in which the ossicles have hour-glass-shaped surfaces, while the Zygophiuræ are those in which the movement of the ossicles on one another is limited by the development of lateral processes and pits.

He justifies the vagueness of his definition of the Streptophiuræ by

* Biol. Centralbl., xii. (1892) pp. 108–23.

† 'Den Norske Nordhavs-Expedition,' xxi., Christiania, 1892, 28 and 9 pp., 5 pls. and 1 map, 1 pl.

‡ Proc. Zool. Soc. Lond., 1892, pp. 175–83 (2 pls.).

showing the variations which the members of the group exhibit in the presence or absence of upper arm-plates, tentacle-scales, tooth-papillæ, radial shields; in *Ophioteropsis* alone of known existing Ophiuroids there are no under arm-plates. In *Ophioscisma* they are imperfect. He reverses the order of arrangement of *Astrophiuræ* proposed by Mr. Lyman, and proposes a grouping which agrees with that of Ljungman.

Attention is also drawn to the large size of the calyceinal plates in a young Ophiuroid.

Development of *Amphiura squamata*.*—Mr. E. W. MacBride has studied the development of the genital organs, pseudo-heart (ovoid gland) and axial and aboral sinuses in this Ophiuroid. In embryos of 200–220 μ in diameter, in which the arms are still undeveloped, the coelom is filled by a mass of mesenchyme. Covering the external wall of the stone-canal there is a single layer of nuclei; this layer is the first rudiment of the pseudo-heart. Proliferation soon commences in this layer. When the embryo has a diameter of 300 μ , the first rudiments of the axial sinus are visible. The author has been able to distinguish three separate rudiments, all of which have been confounded by most observers under the name of axial sinus. Ludwig, however, has distinguished one, probably of enterocœlic origin, from the axial sinus proper. One sinus is formed as an involution of the coelom underneath the rapidly growing rudiment of the pseudo-heart; and another may be described as a chink between the aboral part of the stone-canal and the body-wall. This last soon closes, embraces the basal part of the stone-canal, and at a later period, extends up on to the sides of the pseudo-heart. The second sinus forms the rudiment of the aboral "pseudo-hæmal sinus"; it soon closes, and the large cells in the aboral part of the pseudo-heart migrate along with it to form the genital rachis. The gonads are swellings of this rachis, and the testes develop more rapidly than the ovaries.

Where proper precautions are taken to ensure the penetration of the osmic acid, the structure of the pseudo-heart appears to be that of a uniformly staining plasma, supported by a fibrous network with numerous cells; no lacunæ are visible. There is no trace of either oral or aboral hæmal rings. What have been taken to be vessels seem to be appearances due to the cell-plasma of the cells on the dorsal side of the nerve-cord.

Asteroidea of the 'Prinz Adalbert.'†—Dr. M. Meissner has a report on the eighteen Starfishes collected at various places during the voyage of the German ship 'Prinz Adalbert': *Echinaster cylindricus* from Callao, *Goniodiscus sanderi* from Zanzibar, and *Astropecten latespinosus* from the Inland Sea of Japan are described as new. Most of the species are well known.

New Antedon from Mauritius.‡—Prof. F. Jeffrey Bell describes a new species of Comatulid—*A. emendatrix*—from Mauritius, which belongs to the group called by the late Dr. H. Carpenter the "*A. palmata*

* Zool. Anzeig., xv. (1892) pp. 234–7 (2 figs.).

† Arch. f. Naturg., lviii. (1892) pp. 183–90 (1 pl.).

‡ Ann. and Mag. Nat. Hist., ix. (1892) pp. 427 and 8 (1 pl.).

group," but is distinguished from any known member by what appear to be definite characters. He points out, however, that we are at present, owing to the want of series of specimens, in the stage of making species. When larger series are before us, "another part of our work will begin."

Deep-Sea Holothurians from the Indian Ocean.*—Dr. J. H. Tull Walsh has a report on the eighteen species dredged in deep water by the Survey Steamer 'Investigator.' *Amphigymnas* (*A. multipes*) is a new genus of the Deimatidæ, with an ovoid body and narrow tail-like extremities; *Apodogaster* (*A. alcocki*) is a new genus of Psychropotidæ, with a long, flat and worm-like body; *Pannychia wood-masoni*, *Benthodytes ovalis*, *B. gelatinosa*, and *Trochostoma andamense* are new species.

Cœlenterata.

Stephanophyes.†—Prof. C. Chun begins a monograph on the Siphonophora of the Canary Islands with an account of *Stephanophyes superba* and the family Stephanophyidæ. He apologizes for trenching on a province which Hæckel has recently surveyed in his 'Challenger' Report, but believes that he has something new to say about *Stephanophyes*, and differs moreover from Hæckel in regard to the phylogeny of Siphonophora.

Stephanophyes superba, allied in habit to *Praya* (or *Lilyopsis*), is the most complicated of Calycophoridæ. It has two kinds of "Fangfäden"; one set inserted in the usual fashion at the base of the stomach-sacs, and bearing the reniform batteries characteristic of Calycophoridæ, the other set attached to mouthless polypoid appendages with aberrant acorn-like stinging-knobs.

The stem bears anteriorly the chief swimming-bells, then groups consisting of gastral-polyp, covering protective flap, several male or female gonophores, and a special swimming-bell, while between each group there are palp-like polyps with heteromorphous stinging-knobs.

As to the position of *Stephanophyes* among other Siphonophora, the following classification may be noted.

Calycophoridæ Leuckart.

I. Fam. Monophysidæ Claus.

1. Subf. Sphæronectidæ.
2. Subf. Cymbonectidæ.

II. Fam. Diphyidæ Eschsch.

1. Subf. Epibulidæ (Diphyopsidæ).
2. Subf. Abylidæ.
3. Subf. Amphicaryonidæ.
4. Subf. Prayidæ.

III. Fam. Stephanophyidæ Chun.

IV. Fam. Desmophyidæ Hæck.

V. Fam. Polyphyidæ Chun.

The family Stephanophyidæ, which includes the single genus *Stephanophyes* Chun, is characterized as follows. The swimming-bells are rounded, not angled, with dichotomous oil-reservoirs, disposed with

* Journ. Asiatic Soc. Bengal, lx. (1891) pp. 197-204.

† Abh. Senckenberg. Nat. Gesell., xvi. (1891) pp. 553-627 (7 pls.).

more than two in one plane; the stem-groups include tile-like protective rounded flaps traversed by six vessels, gonophores, and special swimming-bells; in the internodes are heteromorphous tentacles on small mouthless polyps.

Prof. Chun describes in detail the principal swimming-bells, the groups on the stem and their various components. This type is the only Calycophorid as yet known in which between the older groups new stem appendages are secondarily interpolated. He explains the development of the secondary reniform stinging-knobs and the stages in the production of gonophores. Against Weismann and others he regards it as probable that the gonophores with medusoid structure are not retrogressive modifications of Medusæ, but on the contrary, that in many Siphonophora (Rhizophysæ and Physaliæ) free Medusæ are formed in progressive evolution from sessile gonophores.

Female Gonophores of *Errina labiata*.*—Dr. S. J. Hickson has been able to show that the ripe ovum of this Hydrocoralline is covered by layers of both ectoderm and endoderm; this discovery confirms the accuracy of the diagrammatic figure of the female gonophore which the author has recently published.

Lucernariidæ of East Spitzbergen.†—Dr. G. Antipa finds that the three species of Lucernariidæ collected by the Bremen Expedition at East Spitzbergen all present a character first noticed by Prof. Haeckel in *Lucernaria (Lucernosa) bathyphila*; the gonads, instead of having a simple structure, are much more complicated; each gonad consists of numerous separate genital saccules, which all form lobate glands; each saccule is formed of numerous follicles which have their own sinus and duct. He proposes, therefore, to form *Lucernosa* into a distinct genus, and he gives detailed accounts of the structure of the three new species, which he calls *L. Walteri*, *L. Kükenthali*, and *L. Haeckeli*.

Nervous System of *Hydra*.‡—Dr. R. Zoja gives a short summary of the results he has attained by the use of methylene-blue staining of living *Hydræ*. Under the cuticle two or more noduli may be seen in the area of one epithelio-muscular cell; they have a rounded central part, from which numerous fibres radiate out irregularly. These either disappear in the surrounding tissue, or coil spirally round fibres coming from other noduli, or become connected with other forms of fibres, or form chains. These chains have always a spiral fibrillar structure. There may also be seen rich and complicated coils of fibres, fine plexuses formed of the same fibres as those which surround the curved part of the epithelio-muscular cells. From the stinging cells there are given off rigid fibres, which generally radiate from one point. The author believes in the nervous nature of these various forms of fibres on account of their specific coloration, the similarity of the nuclei of the coils with the nuclei of the ganglion-cells described by Schneider, and on the account of their connection with the epithelio-muscular cells and the urticating capsules.

* Zool. Anzeig., xv. (1892) pp. 237 and 8.

† Zool. JB., vi. (1892) pp. 377-96 (2 pls.).

‡ Zool. Anzeig., xv. (1892) pp. 241 and 2.

Porifera.

Anatomy of *Leucosolenia clathrus*.*—Mr. E. A. Minchin has been able to discover the oscula in this sponge, from which they have hitherto been supposed to be absent. He finds, indeed, that the oscula are very large and distinct, though they are provided with a sphincter by which they can, for a time, be completely closed. This sphincter consists of two layers of ectoderm, with a few scattered amoeboid cells between; the contractile cells are the ectodermal epithelium. In connection with this point reference is made to the division by von Lendenfeld of the Cœlenterata into Mesodermalia (Sponges) and Epithelaria (other Cœlenterata), and it is pointed out that the only chief organs of the sponge which can certainly be said to be of mesodermal origin are the connective tissue system and the generative elements. The author gives a graphic explanation of the cause of the general error as to the absence of oscula, and shows that Haeckel's four varieties of this sponge are only different states of contraction; they are no more zoological varieties than a polyp with contracted tentacles is a variety of a polyp with expanded tentacles. The endoderm has been described as multilaminar, but this is merely temporary, and is a mechanical result of the contraction of the whole sponge.

Development of Gemmules in *Ephydatia fluviatilis*.†—Mr. W. Zykoff is, in opposition to Goette, strongly of opinion that neither the canals nor the flagellated chambers take any part in the formation of the gemmules of this freshwater Sponge. As the yolk-substance becomes massed up and continues to increase the future gemmule may be seen dividing into two parts—the central mass which consists of yolk-cells with amoeboid cells of the mesenchym scattered here and there amongst them, and the peripheral layer which consists of several rows of mesenchym cells and gradually passes into the surrounding tissue of the mesenchym. The further development of the gemmule consists in the peripheral cells taking on a club-shaped form, when their thickened ends with the nuclei are directed outwards, the median part thins out, and the inner end is flattened out; these cells are arranged radially in one layer, and not in two or three, as Goette supposes. In consequence of this arrangement they form a continuous layer on the spherical surface of the central mass of the future gemmule. Later on, the amphidiscs appear between the club-shaped cells of the envelope; the author was unable to detect the silicoblasts figured by Lieberkühn. The formation of the gemmule is completed by the development of two chitinous cuticles; and after this the club-shaped cells lose their definite form and are gradually absorbed.

Protozoa.

Argentine Protozoa.‡—Prof. J. Frenzel describes *Guttulidium tinctum* g. et sp. n., a sluggish naked amoeba with hardly more than a suggestion of pseudopodia, and with a compact, angled nucleus;

* Quart. Journ. Micr. Sci., xxxiii. (1892) pp. 477-95 (1 pl.).

† Bull. Soc. Imp. St. Petersburg, 1892, pp. 1-16 (2 pls.).

‡ Bibliotheca Zool., Heft 12 (1892) pp. 50 (6 pls., not published).

Saccamæba punctata g. et sp. n., whose pseudopodia, though more distinct than in the preceding genus, are mere blunt protrusions; *S. verrucosa* = *Amœba verrucosa* Ehrbg.; *S. lucens* sp. n., containing crystals; *S. magna* sp. n., 70 μ in length by 40 μ in breadth; *S. villosa* = *Amœba villosa* Wallich; *S. cubica* sp. n., of cubical shape and with radial arrangement of granules; *S. morula* sp. n., inclining towards the genus *Amœba*; *S. renacuago* sp. n., from the rectum of the larvæ of *Bufo*, with pseudopodia approaching the finger-shaped protrusions of *Amœba*; several doubtful species of *Saccamæba*; *Pelomyxa villosa* Leidy; *Amœba proteus* Leidy; *A. hercules* sp. n., with a cuticular envelope and a median diameter sometimes measuring 100 μ ; *A. pellucida* sp. n., sometimes as large as the preceding species, but very clear in its contents, and with a very marked differentiation of the plasma into two regions; *Dactylospærium radiosum* Ehrbg.; *Tricholimæx hylæ* g. et sp. n., with one very short flagellum and a marked streaming of the plasma, occurring in the terminal part of the intestine of the larvæ of *Hyla*; *Micromastix Januarii* g. et sp. n., with a flagellum shorter than the diameter of the cell; *Mastigella polymastix* g. et sp. n., occupying a position near *Mastigamæba*; *Limulina unica* g. et sp. n., with a posterior flagellum; *Mastigina chlamys* g. et sp. n., with the flagellum situated over the nucleus; *M. paramylon* sp. n.; and *Mastigamæba Schulzei* sp. n.

Amœbæ.*—Prof. R. Greef continues † his account of his studies of amœboid forms. From Ostend he obtained five species of marine Amœbæ. A very detailed account is given of *A. fluida* Gruber, which was found in astounding numbers, and lived over the winter. The author states that he has now been able to find in all Amœbæ examined by him, the thick outer tegument which he first observed in terrestrial forms. In *A. fluida* this tegument is constantly broken through at one spot, and the opening leads directly into the interior of the body; through this opening and it only the protoplasm sends out its pseudopodia to the exterior. This species is, therefore, one of the monothalamous Rhizopoda. From the observations which Prof. Greef was able to make he is led to the conclusion that the body of *A. fluida* is surrounded by a thin, very flexible, resistant, and perhaps chitinous integument. The consistency of the protoplasm of this creature is so slight that the granules suspended in it exhibit a lively molecular movement, such as the author described some years since in *Pelomyxa palustris*. Some account is also given of *Amœba crystalligera*, and the whole may be specially recommended to those microscopists who devote themselves particularly to the Rhizopoda.

Balantidium Coli.‡—Herr J. Mitter has examined a man who for several years was engaged in the care of pigs, and was infested by a number of these intestinal parasites. He shows that the pig is to be regarded as the intermediate host, and that the parasite has considerable pathological significance.

* Biol. Centralbl., xii. (1892) pp. 373-84.

† See *ante*, p. 51.

‡ 'Beitrag zur Kenntniss des Balantidium Coli im menschlichen Darmkanale,' Kiel, 1891. See Centralbl. f. Bakteriologie u. Parasitenkunde, xii. (1892) p. 111.

Sporozoon Parasitic in Muscles of Decapod Crustacea.*—MM. F. Henneguy and P. Thélohan call attention to the presence in the muscles of *Palæmon rectirostris* of a form which appears to be intermediate between the Sarcosporidia on the one hand, and the Microsporidia and Myxosporidia on the other. *Crangon vulgaris* is also infested by a parasite which gives diseased forms the same chalky appearance as was noted in *Palæmon*; it is also found in the muscles, but is of a somewhat larger size; it is shown by its life-history to be one of the Myxosporidia, and is very close to *Glugea*.

Hæmatozoa of Malaria.†—M. Laveran has recently published an expansion of the treatise on marsh fevers, which appeared in 1884. In it the author not only includes the scattered pieces published in the interval, but also defends his claim to the priority in the discovery of malaria parasites. The first chapter is devoted to the description of the parasites. This is pretty much the same as in the former treatise, but the spheroidal forms are now stated to be the most common, while with regard to the flagellated forms it is now stated that when the flagella become separated from the main body, each flagellum becomes an independent organism. Parasites were found 432 times out of 480 examinations. After stating the technique for observing the parasites, the author discusses the nature of the parasites, and places them among the Sporozoa.

In part 4 the author discusses the question of the polymorphism of the parasites. He inclines strongly to the side of polymorphism, declaring that the type of the fever is determined rather by individual conditions than by the variety of the parasitic elements in the blood. Part 5 deals with the biological conditions of the parasites, their presence in the soil, the source of infection, and the incubation period. According to the author, the incubation period is from 6–10 days, although the fever may remain latent some while longer. After discussing the treatment of the disease, the work ends with a description of forty-seven cases of the malady.

Malarial Microbiosis.‡—Dr. Danilewsky tries to show that birds, like men, suffer not only from chronic, but acute malaria. The chronic form is, as a rule, well borne, the parasites disappear at times, and then spontaneously reappear in the blood, just as in man, and the author appears to think that this proves the connection of the avian parasites with those of man. In the acute form the red corpuscles are suddenly attacked, Cytozoa resembling pseudo-vacuoles appearing within them. These increase in size, and fill up with melanin granules. Besides the presence of the parasites in the blood, the birds suffer from general symptoms, such as fever, loss of appetite, emaciation, dyspncea. The parasite becomes fully developed in 3-4 days, having undergone the usual fission processes, with the formation of spores, which appear free in the blood.

The most important difference between the chronic and acute forms

* Comptes Rendus, cxiv. (1892) pp. 1552-5.

† 'Du Paludisme et son hématozoaire,' Paris, 1891, 8vo, pp. 300. See Centralbl. f. Bakteriöl. u. Parasitenk., xi. (1892) pp. 510-2.

‡ Annales Inst. Pasteur, 1891, p. 578. See Centralbl. f. Bakteriöl. u. Parasitenk., xi. (1892) pp. 513-5.

is found in the spleen, which in the former becomes enlarged, and of a brownish black colour, in consequence of the deposit of melanin; while in the acute form the spleen becomes smaller, anæmic, and pale brown.

The parasite of the acute form, different from that of the chronic, is called *Cytosporon malarizæ*, in order to distinguish it from the *Cytamœba* of man, which has the power of movement. The word *Cytamœba* is used instead of *Hæmamœba* in order to express the existence of a parasite within a corpuscle.

Although movements were not observed, yet their appearance within blood-cells points to the fact that these parasites are possessed of a transitory mobility. In the acute form the *Cytospora* form spores, and also differ from the parasites of the chronic form in being located at one pole of the corpuscle pushing the nucleus towards the other, while in the chronic the nucleus remains in its normal position.

On the third day after the appearance of the parasite the characteristic melanin granules are observable, and shortly after this the spores, the diameter of which is about eight times less than that of the nucleus of the corpuscle, while their shape is more or less rounded. The spores are set free in the plasma by the destruction of the corpuscle, which first becomes colourless and then disappears.

The spores are easily stained with methylen-blue and safranin. They are elliptical in shape, and resemble the spores of some *Sarcosporidia*, and still more the *Microsporidia* of Pébrine. The further destination of these spores is uncertain, but it is probable that they accumulate in the spleen, bone-marrow, and lymphatic system.

With regard to increased temperature, the author notes from numerous observations that the rectal temperature of healthy birds is from 41.5° – 42.5° , and that anything over 43° is to be regarded as febrile.

According to the author, the principal focus of blood-parasitism is to be sought, not in the blood itself, but in the blood-forming organs in the spleen and bone-marrow, both in the cold- and warm-blooded animals, and it is in these situations that individual differences exert their influence in the microbiosis of the blood.

Intracellular and Intranuclear Parasitism in Man.*—M. Sondakewitsch has been able to demonstrate in ninety-five cases of cancer intracellular parasites belonging to the class Sporozoa, and the appearances of these microbes are depicted in three plates accompanying the text. The cancerous tumour was fixed with Flemming's fluid and osmic acid, and afterwards treated with Müller's fluid. The sections were stained by various methods, but chiefly with borax-carmin and watery methylen-blue.

The author shows that Virchow had observed and portrayed these parasites forty years ago. The author promises a further communication on the relation of the parasites to the protoplasm and the nucleus, and on the typical giant-cells of carcinomatous neoplasms.

Parasites in Cancer.†—Prof. E. Metschnikoff, after an inspection of the specimens of cancer of pancreas and lymphatic glands submitted to him by Sondakewitsch, fully confirms the latter's observations. The

* *Annales Inst. Pasteur*, 1892, p. 145. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xii. (1892) p. 39.

† *Annales Inst. Pasteur*, 1892, p. 158.

small round bodies within the plasma of the cancer cells he thinks are certainly parasites and most probably coccidia. The author also mentions having seen similar appearances in preparations by Foà and also by Malassez and his pupils.

The author points out that inoculation experiments with coccidia must necessarily be difficult, as each kind of animal is infested with a definite species of the parasite and hence the successful transference of any given coccidium to an animal cannot be regarded very hopefully. On the other hand the similarity between carcinoma and psorospermiosis of rabbits suggests the notion that the transference of the disease would be less successful with fresh material than with such as had remained for a shorter or longer period outside the body. The psorospermiosis of rabbits is spread not by direct contagion, but by means of spores which after the death of the animal are formed in the surrounding medium in a manner akin to that of a "miasm."

Parasitic Sporozoa of Cancer.*—Dr. G. Sawtschenko describes a parasite similar to that found by Sjöbring in a case of cancer. Owing to the fact that the parasite was observed in great numbers, especially in certain parts of the cancer, the author was able to link together various forms which may be taken to represent different stages in the developmental cycle. The tumour, from a case of cancer of the lip with metastatic deposits in the lymphatic glands, was treated with Flemming's fluid and stained with safranin and picric acid, or with gentian-violet and eosin. The parasite is clearly represented in a series of 19 figures showing its position within the epithelioid cells and its relation to the nucleus. Most often the parasite is seen as a collection of spheroidal vacuoles of variable size. These vacuolar forms appear to have a double contour, and some central granules. In less frequent cases the double contour is more distinct and the parasite is larger. It is in this stage that it may contain numbers of the smaller forms (sporophore and sporocyst) or coiled up or spindle-shaped germs. Some of the illustrations depict an epithelial cell with a vacuole, the latter containing the shrivelled up remains of its former tenant or a distinctly spheroidal nucleated granular body, having much resemblance to an ordinary epithelial cell. It is quite unnecessary to enter into the author's speculations, for which the original may be consulted, but the illustrations given have the great merit of showing quite distinctly the appearances observed.

Psorosperms (Sarcosporidia) in Human Heart Muscle.†—The occurrence of Sarcosporidia in man has been denied by most observers. Hence the discovery, by Dr. Rosenberg, of Miescher's corpuscles in human heart muscle has special interest. The patient was a woman of about forty years of age, who died of pleurisy and endocarditis verrucosa. In the heart was found a cyst 5 mm. long and 2 mm. broad, and this was at first supposed to be an echinococcus bladder. Neither scolex nor hooks was found. On teasing out a portion of the cyst it was found to contain numerous corpuscles, which were highly refractile and structureless, resembling in these respects the bodies in mollusca contagiosum.

* *Centralbl. f. Bakteriol. u. Parasitenk.*, xii. (1892) pp. 17-28, 1 pl. (19 figs.).

† *Zeitschr. f. Hygiene*, xi. No. 3. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xi. (1892) p. 739

The corpuscles seemed contained in a sort of membrane. The shape of the corpuscles was very various, round, egg-shaped, kidney-shaped, longish oval, &c. Characteristic crescentiform germs, pairs in conjugation, such as according to Bütschli occur only in Sarcosporidia, but not in Coccidia, were observed. According to Blanchard's classification the parasite has been named *Sarcocystis hominis*.

It was not at all clear in this case what sort of serous cyst it was which sheltered the parasite on its inner wall.

Parasitism in Carcinoma.*—Prof. W. Podwyssozki and Dr. J. Sawtschenko consider that the constant presence of parasites in carcinoma is to be regarded rather as a commensalism or symbiosis of Sporozoa and epithelial cells than as the cause of the epithelial proliferation. They seem to prefer to let the definite solution of the problem remain in abeyance and go no farther than certifying the existence of parasites within and between the cells of cancerous growths and deposits. But about the existence of parasitic Sporozoa they have no doubt. The method adopted in demonstrating the Sporozoa was to harden the specimens in Flemming's fluid, and then to stain with anilin-water-safranin, after which the preparations were treated with alcohol to which a few drops of picric acid were added. The longer the pieces of tumour were left in the Flemming's fluid, the more distinct the parasites were rendered, their plasma assuming a dark brownish hue while that of leucocytes and of the tissues was unaffected. Red corpuscles take on a similar, but not so deep a tone. By double staining with gentian and safranin anilin water the chromatin of the sporozoa is coloured red, while that of epithelial cells is blue.

In this way they were able to demonstrate, in more than 20 cases of cancer (testicle skin, lip, breast, stomach), the existence of intracellular sporozoa; the parasite was found in greatest numbers in soft medullary cancer and much less frequently in epithelioma of lip and eyelid. The appearances presented by the different preparations were divisible into two varieties, those in which separate parasites were observed, and those in which conglomerates or collections of individuals were found.

The former seem to vary much in size and indeed in number, frequently more than one being visible within the cell plasma, wherein they appear as spheroidal or ovoidal bodies. The general mass of the parasite appears yellow, but contains red staining chromatin.

The conglomerates are more frequently seen in the intra-cellular spaces than within cells.

Many of the epithelioid cells which contain parasites exhibit well marked mitosis of the nucleus, but this appearance is not constant, and the karyokinetic figures may be present and the parasites absent, and, *vice versá*, the parasite be present without mitosis of the nucleus, so that no immediate connection appears to exist between mitosis and parasitism.

The author's paper is excellently illustrated by means of numerous coloured figures depicting the parasites under numerous conditions and showing their variable appearances.

* Centralbl. f. Bakteriöl. u. Parasitenk., xi. (1892) pp. 493-500, 532-8, 559-65 (2 coloured pls.).

BOTANY.

A. GENERAL, including the Anatomy and Physiology
of the Phanerogamia.

a. Anatomy.

(1) Cell-structure and Protoplasm.

Callus and Paracallus.*—According to Mr. S. Le M. Moore, two substances have hitherto been confounded under the name of callus,—true callus, which neither gives proteid reactions nor peptonizes, and a proteid substance to which he gives the term *paracallus*. Both substances have the function of obliterating the sieve-pores; their microchemical reactions are given in detail.†

Mr. Moore corrects his previous statement that the callus of the vegetable-marrow gives proteid reactions. On the abaxial side of the bast of the fig, the sieve-plates are closed by paracallus which results from the hardening of the "Schleimkopf." In *Ballia* we find paracallus alone; *Rosa canina*, *Ampelopsis hederacea* and *Veitchii*, the fig, and *Macrocystis pyrifera* have paracallus as well as callus, while callus alone occurs in the ash and the elm. True callus resists the action of diastatic ferments, but dissolves in a solution of gum arabic; hence there is probably a callolytic ferment in the gum, though the author has not been able at present to detect it. The function of both callus and paracallus is to protect the plant by preventing the formation of new shoots under only temporarily favourable conditions of heat, light, or moisture.

Alleged Proteid-substances in Cell-walls.‡—Mr. S. Le M. Moore has investigated the alleged occurrence of proteids in cell-walls, and thinks the reactions may possibly be due rather to special conditions of tannin or to the presence of glucosides. That the substance found is not a peptonizable proteid is shown by the fact that the reactions are exhibited as well after peptonization as before; nor can it be a tyrosin, since the tests remain after soaking in hydrochloric acid. Catechu gives many of the reactions of proteids. The behaviour of lignified cell-walls to various reagents proves the existence in them of an iron-greening tannin; this occurs in the meristem of the stem of *Isoetes lacustris*; an iron-blueing tannin is found in the collenchyme of *Rosa canina*. The hard bast of the fig contains a glucoside in its walls. The evidence of the presence of a glucoside is often obscured in lignified cell-walls by the appearance in them of a red colour on boiling with dilute hydrochloric acid. If the cell-walls contained a proteid, they should take up carmine and anilin, which they do not. It is possible that the presence of a glucoside in lignified cell-walls may give them their property of conducting fluid. The precisely similar colour assumed with methyl-green by lignified cell-walls and by the

* Journ. Linn. Soc. (Bot.), xxix. (1892) pp. 231-40 (1 pl.). Cf. this Journal, 1891, p. 615.

† Cf. *infra*, p. 711.

‡ Journ. Linn. Soc. (Bot.), xxix. (1892) pp. 241-62. Cf. this Journal, 1888, p. 602.

nucleus suggests the possibility of an iron-greening tannin being present in the latter. It is doubtful also whether proteids occur in the latex of the fig, since its apparent proteid reactions may be due to an iron-greening tannin.

Processes of Aggregation in the Living Cell.*—Dr. P. Klemm discusses the phenomena of aggregation which can be induced in the living cell, as, for example, in those of the tentacles of *Drosera* by the action of minute quantities of ammonia; and dissents from Loew and Bokorny's view † that it is due to the presence of an "active albumen." The substances capable of producing this reaction are—in addition to ammonia—ammonium carbonate, potassa, soda, organic bases, and neutral salts of ammonia and of the organic bases, but not neutral salts of inorganic bases. The author maintains that, at least in many cases, the excretion of granular bodies in which the phenomenon consists, takes place not in the protoplasm but entirely in the cell-sap. In addition to albumen, tannin, and lecithin, the author finds phloroglucin present in the excreted substances. He concludes that the phenomenon known as "aggregation" is merely the manifestation of different processes which present a similar external appearance. In the majority of cases it is clear that tannin plays the principal part in the phenomenon. The "active albumen" is a purely hypothetical substance.

In another paper ‡ Dr. Klemm adduces further evidence that in the *Crassulacæ* the excretion of granular substance takes place in the cell-sap and not in the protoplasm.

Action of the Nucleole in the Turgidity of Cells.§—M. C. Decagny states that in *Phaseolus* the embryo is enveloped in a close layer of endosperm, resting on another layer of endosperm which clothes the portion of the embryo-sac below the embryo. In the plane of junction of these two layers are a number of very large nuclei with large nucleoles; also a very great number of vesicles; these latter he asserts to be vacuoles of the nucleoles which have escaped from them and have entered the nuclear sac. There they have become invested with a solid membrane, and have swollen up greatly, finally forming a kind of network, and causing the well-known turgidity of the nuclei of the endosperm.

Transformations of Cellulose.||—M. L. Mangin calls attention to the transformation, caused by the action of sulphuric acid or zinc chloride, of cellulose into hydrocellulose or amyloid which is coloured blue by the action of iodine. He regards hydrocellulose as one of the first members of an imperfectly known series resulting from the action of these reagents on cellulose. Its production requires a definite degree of concentration of the acid. The action of alkalies or of the cupro-ammoniacal reagent effects the same change with more certainty. He treats in detail of the reactions for cellulose, which he divides into three classes:—(1) Iodine reagents; (2) staining reagents of the group orseillin BB, in an acid bath; (3) the series of benzidin reagents, in an

* *Flora*, lxxv. (1892) pp. 395-420.

† Cf. this *Journal*, 1890, p. 348.

‡ *Ber. Deutsch. Bot. Gesell.*, x. (1892) pp. 237-42.

§ *Comptes Rendus*, cxiv. (1892) pp. 506-7.

|| *Op. cit.*, cxiii. (1891) pp. 1069-72.

alkaline bath. Others, such as methylin-blue proposed by Gardiner, and anilin-brown and quinolain-blue proposed by Van Tieghem, are not so satisfactory.

(2) Other Cell-contents (including Secretions).

Spherites in the Amaryllidaceæ.*—Dr. L. Re has detected spherites in a number of species of *Agave*, their abundance and distribution varying greatly with the species. In *A. mexicana* they are especially abundant in the bracts, flowers, and fruit, but most so in the flower-stalks, where they are of enormous size. Treated with a dilute solution of ammonium oxalate, they manifest a concentrically stratified structure. Bodies of a like character were found also in *Fourcroya gigantea*, *Polygonum tuberosa*, and *Crinum asiaticum*.

Chlorophyllane.†—M. A. Étard classifies into three groups the substances extracted from chlorophyll by carbon bisulphide, and into four groups those obtained by extraction with alcohol. From experiments made on twenty different species of plants, he comes to the conclusion that the substance described as chlorophyllane by Hoppe-Seyler, and identified by Tschirch with hypochlorine, is not a true chemical compound, but is a mixture of substances from which the green colour can be removed by animal charcoal without affecting the crystalline character.

Iron in Plants.‡—According to Dr. H. Molisch, iron occurs in plants in two forms, in that of ordinary iron-salts, and in such close combination with organic substances that it cannot be detected by the ordinary reagents. In the latter form it is universal, iron being an invariable constituent of the ash of plants. In the former state it does not occur in large quantities in Algæ or Fungi, except in some Lichens. In flowering plants many seeds contain iron in this state in their procambium bundles, but it is absent from the endosperm and perisperm, and disappears altogether during germination. "Masked" iron occurs in the cell-wall or in the cell-contents or both; it is especially abundant in lignified cell-walls; and it may be present as a reserve-substance in the globoids of aleurone-grains. In opposition to the usual statement, the author was unable, in any case, to find any trace of iron in chlorophyll. Its presence in the iron-bacteria is not, as was supposed by Winogradsky,§ the cause of the accumulation of iron in certain soils; nor is iron a physiological necessity, since it does not enter into living protoplasm, and it may be replaced, in some cases, by manganese.

Fumarine in the Papaveraceæ.||—M. J. A. Battandier brings forward another argument in favour of the close affinity of the Papaveraceæ and Fumariaceæ, in the fact that he has found fumarine in the leaves of *Glaucium corniculatum*, which belongs to the former natural order. This alkaloid is universally distributed throughout the genera and

* Bull. Soc. Bot. Ital., i. (1892) pp. 288-94.

† Comptes Rendus, cxiv. (1892) pp. 1116-8.

‡ 'Die Pflanze in ihren Beziehungen zum Eisen,' Jena, 1892, 119 pp. and 1 pl. See Bot. Centralbl., l. (1892) p. 370. § Cf. this Journal, 1888, p. 786.

|| Comptes Rendus, cxiv. (1892) pp. 1122-3.

species belonging to the Fumariaceæ. With the exception of berberine, no instance is known of a true alkaloid occurring in two species belonging to different natural orders.

(3) Structure of Tissues.

Spring and Autumn Wood.*—According to M. E. Mer, the distinction between spring and autumn wood is by no means so definite as is often stated, the wood formed in one season having, under special conditions, the general characters of that ordinarily formed in the other season. Moreover a zone of precisely the same character as that known in conifers as autumn wood, and formed about August 15, is formed in the oak about the middle of June. The zone usually called autumn wood should rather be called summer wood. The distinction between the two zones is very conspicuous in woods with large vessels, less so in conifers.

Collenchyme.†—A series of observations made by Herr J. Cohn on the structure and function of collenchymatous tissue lead him to the conclusion that the functions ascribed to it of conducting and of storing up water rest on incorrect observations. Its only purpose which at present has been fully determined is a mechanical one. In its living state the cell-walls of a collenchymatous tissue contain as much as from 60 to 70 per cent. of water, while lignified phloem and xylem contain only from 20 to 40 per cent.; but after drying, collenchyme has no greater power of absorbing water than woody tissue. The water is deposited chiefly in the radial direction, to a certain extent in the tangential, least of all in the longitudinal. The innermost grey layer contains the largest proportion. A specially extensible collenchyme was observed in *Rheum* and *Malva*.

Sieve-tubes of Papilionaceæ.‡—Dr. P. Baccarini describes a structure which he finds very widely distributed among the Papilionaceæ. In the middle of the cavity of the sieve-tubes is suspended a gelatinous mass, usually of a polygonal form, and lying on one side of the tube, but connected with the peripheral protoplasm of the other side by delicate threads. The structure presents the ordinary reactions of the gelatin of sieve-tubes. Its origin varies; in some cases the nucleus takes no part in its formation, while in others it is derived directly from the protoplasm which envelopes the nucleus, and from the nucleus itself.

Caoutchouc cells of Eucommia.§—Prof. F. E. Weiss describes the caoutchouc-containing cells in this plant, of uncertain systematic position, from China. They are very elongated tubes, quite unbranched, and occur in the inner portion of the cortex, in the secondary phloem, and to some extent in the pith. They differ from the latex-cells of the Euphorbiaceæ in containing only a single nucleus, and in arising *de novo* in all secondary growths, such as the secondary phloem, and in new shoots and leaves. During the early stages of their growth, the

* Comptes Rendus, cxiv. (1892) pp. 501-3.

† Jahrb. f. Wiss. Bot. (Pring-heim) xxiv. (1892) pp. 145-72 (2 figs.).

‡ Malpighia, vi. (1892) pp. 53-7.

§ Trans. Linn. Soc. Lond. (Bot.), iii. (1892) pp. 243-54 (2 pls.).

protoplasm of these cells contains a number of smaller and some very much larger granules; the latter are of the nature of caoutchouc, and increase in number till they become welded into a solid and extremely elastic mass.

Secondary Xylem of the Apetalæ.*—Pursuing his investigation of this subject, M. C. Houlbert now describes the structure of the secondary xylem in the orders of Apetalæ with inferior ovary.

The structure of the xylem of the Loranthaceæ is so different from that of the Santalaceæ that the two families cannot be regarded as nearly allied. From the same point of view the Juglandaceæ appear to form an isolated group of the Apetalæ, and not to present any close affinity with the Myricaceæ.

The Cupuliferæ may be divided, according to the structure of their xylem, into the two groups Betuloïdeæ and Castaneoïdeæ. In the former the structure of the secondary xylem resembles that in the Betulaceæ, while in the latter it calls to mind that which occurs in the Urticoïdeæ; the vessels are rounded and nearly always isolated. Judging from this character the oaks and chestnuts are probably two groups with a common origin. In the genus *Fagus* there are two different types of structure, one (*F. betuloïdes*, &c.) presenting the characters of the Betulaceæ, the other (*F. sylvatica*, &c.) those of the Platanaceæ.

Formation of Rods in Secondary Wood.†—Herr W. Raatz has investigated the formation of rod-structures in a number of Coniferæ, in *Hippophaë rhamnoides*, *Casuarina equisetifolia*, and *Salix fragilis*, which cross the tracheids or vessels at a right angle. They may occur in all parts of the wood and secondary cortex, in the root, stem, and branches, in all trees that increase by an annual cambium ring. They result from the coalescence of tangential walls, which thus causes accumulations of cellulose. The author argues against the theory of Sanio, that the existence of these rods indicates the origin of the cambium from a single initial mother-cell. He concludes also from his observations that the cambium increases by intercalary division of its cells arranged in radial rows; and that the intensity of growth of the cambium is greater on the xylem than on the phloem-side.

Fibrovascular Bundles of the Flax.‡—Sig. F. Tognini describes in detail the course of the vascular bundles in the root, stem, leaves, and cotyledons of *Linum usitatissimum*. The chief departure from the normal structure is that the xylem of the leaf-trace system ends free in the epicotyledonary axis, without uniting with the cotyledon-traces.

Medullary Bundles of the Cichoriaceæ.§—Herr O. Kruch states that supporting bundles are widely distributed in the pith of the Cichoriaceæ. They are always of more or less reduced structure, either consisting only of sieve-tubes, or containing also phloem-elements, vessels, and mechanical cells, the sieve-tubes being always the first formed

* Comptes Rendus, cxiv. (1892) pp. 1217-8. Cf. this Journal, *ante*, p. 500.

† Jahrb. f. Wiss. Bot. (Pringsheim), xxiii. (1892) pp. 567-636.

‡ Atti Real. Ist. Bot. Univ. Pavia, ii., 21 pp. and 3 pls. See Bot. Centralbl., l. (1892) p. 337.

§ Ann. R. Ist. Bot. Roma, iv. pp. 204-91 (15 pls.). See Bot. Centralbl., 1892, Beih. p. 114. Cf. this Journal, 1890, p. 353.

elements. They are always of secondary origin, springing from fully developed pith-cells. The passage of the bundles from the vascular-bundle system into the pith always takes place in the nodes; the medullary bundles begin to be formed either in a node or in some one spot in an internode. Their presence is of no value for the classification of the group.

Anomalous Stem of *Thunbergia*.*—Prof. R. Chodat and M. C. Roulet describe the following anomalous structure in the stem of *Thunbergia laurifolia* (Acanthaceæ). The xylem consists of four arcs, two thinner and two thicker. In the two thicker arcs islands of parenchymatous and sieved xylem, elongated tangentially, alternate in the radial direction with lignified bands of woody fibres; they are separated from one another by lignified vascular xylem. The two thinner arcs acquire this structure only at a later period. According to the authors, these islands of sieve-tubes are bands of sieved xylem, like those of *Dicella*, and the generating layer is continuous; the pericycle takes no part in the formation of the uniting tissues. *Hexacentris coccinea* has a similar structure.

(4) Structure of Organs.

Archegone and Apical Growth of the Stem in Coniferæ.†—Mr. D. M. Mottier has investigated these points of structure in *Tsuga canadensis* and *Pinus sylvestris*. He finds the neck of the archegone (corpuscle) to consist, in *Tsuga*, frequently of two, and occasionally of three cells; in *Pinus sylvestris* the cells of the neck form two layers instead of one.

With regard to the apical growth of the stem in both species, his observations lead him to the conclusion that we cannot say with certainty that there is a single cell at the apex of the stem, unless it be in the stem of the young plant, and even then it is not absolutely certain.

Anthocyanic Flower of the Carrot.‡—Dr. M. Kronfeld describes under this term the central coloured flower in the umbel of *Daucus Carota*, the red colour of which is due to the presence of anthocyan in the petals, and also frequently in the stamens, nectary, and ovules. The petals are larger, and are recurved inwards, and the filaments are also curved inwards, as is their ordinary position in the bud. In opposition to the usual statement, Dr. Kronfeld asserts that the anthocyanic flowers are usually hermaphrodite, less often female, and that they are generally fertile. He believes them to be cleistogamous and self-fertilized.

Fruit and Seed of *Eugenia*.§—Dr. E. Baroni describes in detail the anatomical structure of the fruit and seed of *Eugenia myrtillifolia* (Myrtaceæ). Besides chlorophyll, the seeds contain a colouring matter allied to anthocyan, tannin, starch, sugar, and essential oils.

Borragoid of the Borriginaceæ.||—Herr K. Schumann points out that the peculiar inflorescence of the Borriginaceæ, to which he has applied the term "borragoid," and which attains its fullest development in *Anchusa*, is merely an extreme case of the extra-axillary inflorescence

* Arch. Sci. Phys. et Nat., xxvii. (1892) pp. 27-9.

† Bot. Gazette, xvii. (1892) pp. 141-3 (1 pl.).

‡ SB. K. K. Zool.-Bot. Gesell. Wien, xli. (1891) pp. 83-4.

§ Bull. Soc. Bot. Ital., i. (1892) pp. 275-83.

|| Ber. Deutsch. Bot. Gesell., x. (1892) pp. 57-63 (1 fig.).

that occurs also in several other natural orders. The cause of this peculiar position is the setting up of an intercalary growth between the inflorescence and the supporting leaf.

Multiple Buds.*—From a large series of observations M. W. Russell has arrived at the following conclusions on this subject.

Lateral buds may be produced at the expense of the constituent parts of the leaf-axil, or at the expense of one part only, and that either the stem, or less often the leaf. They may make their appearance at the growing apex at the same time as their supporting leaf. Every bud at the beginning goes through a double growth; there is, in fact, a growth of its own, and a growth in common with the organs which have formed it. The latter is generally stronger than the former, at all events at first; and in consequence various coalescences are formed, and the apparent insertion of the bud is often carried much above its real insertion. The greater number of leaf-buds and numerous flower-buds are capable of putting forth ramifications from their base, at a time when they themselves are scarcely developed. These buds are the origin of a number of successive ramifications which accompany the bud of the first generation, and which are frequently without supporting leaves proper. These successive ramifications, commonly described by the terms accessory buds of the axillary bud, or multiple buds, behave, from the point of view of their mode of formation, like the axillary bud itself. Hence, as in the case of the latter, there is a constant connection between the appearance of one of them and the number of leaves of the bud from which it springs. Similarly, if the bud of the first generation is coalescent with the axis, its ramifications are coalescent with each other.

The arrangement of these buds always follows the laws of phyllotaxis, even when they have no supporting leaf; the function of protection is in that case filled by the supporting leaf of the bud of the first generation forming round them, by its base or by its stipules, an envelope, which is often persistent. These basilar ramifications have a well-defined biological office. On them depends the ramification of the plants when the axillary bud is transformed into a spine, a tendril, or an inflorescence, or is destroyed accidentally or normally. In a great number of cases these buds remain in the state of dormant buds, and are the origin of the vigorous branches which appear under various circumstances on woody plants. Sometimes they play the part of hibernating buds, enabling the plants to vegetate from one year to the other. Finally, they can develop, in the year of their formation, or in the following year, at the same time as the bud of the first generation; they then tend to render the ramification more bushy.

It may be shown experimentally that the appearance of these buds may frequently continue during the entire life of the plant; it is thus that, if a flower-bud of *Convolvulus*, for example, be suppressed, its basilar ramification takes the characteristics of a flower-bud. If this latter be taken away, a flowering branch of the third generation will make its appearance, followed later on by one of the fourth generation, and so on. Identical results may be obtained in most woody or herbaceous plants, by suppressing successively several generations of flower-buds.

* Ann. Sci. Nat. (Bot.), xv. (1892) pp. 95-202 (4 pls.).

β. Physiology.

(1) Reproduction and Embryology.

Morphology and Physiology of the Sexual Process.*—M. W. Chmielewskij has investigated this subject in some of the lower plants, especially Algæ. He finds that, in *Spirogyra*, when the cells put out their conjugating processes, the tannin, which has up to that time been abundant in the cell-sap, disappears, while the albumen dissolved in the cell-sap passes into another modification. The proportion of these substances in the cell-sap varies with the conditions of vegetation, being largest during the period of rest, and being gradually used up during active growth. When the cells assume their sexual character, large quantities of starch and oil-drops are stored up in the chlorophyll-bands.

When a young zygote of *Spirogyra* is made transparent without destroying the chlorophyll, two chlorophyll bands are readily recognized in it; the one derived from the female cell is coiled spirally, that from the male cell irregularly. This latter undergoes changes as the zygote develops; the pyrenoids and starch-grains disappear, the colour of the band changes from green to yellow-brown, and the band breaks up into pieces which pass into the cell-sap, where they are visible till germination. In the meantime the female chlorophyll-band lengthens, and encloses the whole zygote in its coils.

The conjugation of the male and female nuclei is (in *Spirogyra crassa*) a much more complicated process than has hitherto been supposed. The resulting nucleus of the zygote divides, by karyokinetic division, into four nuclei, of which two break up into fragments and disappear, while the other two, the secondary nuclei, again unite into the definite nucleus of the zygote, which remains till germination.

In *Basidiobolus ranarum* (Entomophthoraceæ) the nuclei of the sexual cells enter the beak and there divide; a daughter-nucleus from each remains in the beak, which separates itself from the true sexual cell by a septum; the protoplasm of one of the sexual cells then passes into the other; and the two nuclei coalesce after a time in the zygote so formed.

The germination of zygotes (of *Spirogyra*) may be promoted by abundant access of air. The period of rest (in *Spirogyra* and *Edogonium*) varies, according to the species, between one and six months.

Impregnation of several Embryos.†—M. G. Chauveaud attributes the occasional occurrence of polyembryony to the existence of more than one male nucleus in the pollen-grain, rather than to the entrance of several pollen-tubes into the embryo-sac. Polyembryony has been observed in several Leguminosæ, in *Iris sibirica*, *Lilium Martagon*, and *Vincetoxicum*; in *V. medium* as many as five embryos have been observed. In those species in which polyembryony occurs, as e. g. in *Vincetoxicum officinale*, it is not uncommon for the pollen-grain to have three nuclei, one vegetative and two generative; these latter have probably increased in number by division after the entrance of the tube into the micropyle. On the other hand the micropylar canal is so narrow

* 'Material. z. Morph. u. Phys. d. Sexualprocesses b. d. niederen Pflanzen,' Charkow, 1890, 80 pp. and 3 pls. See Bot. Centralbl., l. (1892) p. 264.

† Comptes Rendus, cxiv. (1892) pp. 504-6.

that it is difficult to understand how several pollen-tubes could pass through it at the same time.

The author considers, therefore, that in both male and female organs there are several sexual elements; but that, in the majority of cases, these have, in the female organ, been reduced to one, the oosphere. In this view the synergidæ are female sexual cells in course of abortion and suppression; and polyembryony was originally the normal condition of things in flowering plants, the gradual substitution of a single fertile embryo indicating an advance in organization.

Embryo-sac of Phanerogams.*—According to Prof. C. M'Millan the staining reactions of the two nuclei which fuse together in the embryo-sac of Angiosperms differ from one another; those of the micropylar nucleus indicating a male, those of the antipodal nucleus a female character. He regards this fusion, therefore, as a sexual act, resulting in the segmentation of the endosperm-tissue. The embryo-sac, wherever met with, is, in his view, a megaspore.

Heredity and Reversion in Iris.†—Prof. E. Heinricher describes the result of a series of culture experiments, extending over eleven years, on the heredity of an anomalous structure in the flowers of *Iris pallida*. The original anomaly consisted in the presence of an inner staminal whorl, which took the form either of abortive or well-developed stamens, or of staminodes, or of more or less fully developed carpids. With regard to the morphology of these supplemental organs, his observations lead him to the conclusion that they do not form a special whorl, but are derived from the fission of the staminal whorl, even where the supplementary organs take the form of carpids with fully developed seeds and petaloid styles. The reversion thus exhibited is transmitted by inheritance through the seeds.

Self-pollination in the Apocynaceæ.‡—Mr. T. Meehan describes the structure of the showy flowers of *Amsonia tubernæmontana* (Apocynaceæ), which are abundantly fertile, but in which the arrangement of the parts is such that no insect, not even a *Thrips*, can gain entrance to the nectary. The mouth of the tube is so densely matted with hair that if a pollen-clothed tongue were thrust through the mass, it would be thoroughly cleaned. Nor is there any room for an insect's tongue to pass the capitate stigma. To effect pollination the anthers curve over and rest on the stigma.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Germination of *Freesia refracta*.§—M. P. Duchartre describes the germination of the seeds of this species of Iridæ from the Cape; the radicle takes no part in the development but soon perishes, its function being fulfilled by adventitious roots. Some of these have a normal structure, while others are napiform, and serve as temporary

* Bot. Gazette, xvii. (1892) pp. 160-1.

† Jahrb. f. Wiss. Bot. (Pringsheim) xxiv. (1892) pp. 52-144 (2 pls. and 28 figs.).

‡ Proc. Acad. Nat. Sci. Philadelphia, 1892, pp. 162-3.

§ Journ. Soc. d'Hort. France, 1891, pp. 152-60, 215-30. See Bonnier's Rev. Gen. de Bot., iv. (1892) p. 239.

reservoirs of food-material. The tubercles are formed, not at the base of the stem, but in a region commencing with the fourth internode, and extending upwards for a space of five or six internodes. A tubercle thus formed, when placed in the soil, puts out numerous roots, and, at its apex, a kind of rhizome; from this is developed a secondary tubercle, which bears the flowering stem.

Dissemination of the Polygonaceæ.*—Herr U. Dammer describes the various contrivances for promoting the dissemination of the fruits and seeds of the different genera of Polygonaceæ; and the vegetative propagation by means of stolons or gemmæ, such as those in the inflorescence of *Polygonum viviparum*. The dissemination of the fruits is assisted especially by membranous wings, by bristles, and by callosities on the persistent perianth-leaves. The number of these callosities is two or three in those species where the fruit is carried by running water, so that it lies flat on the surface, but only one in those in which the fruit falls into stagnant water. *Rumex* and *Oxyria* are anemophilous, while *Rheum* is entomophilous.

Relationship between the Concentration of the Substratum, and Turgor and Growth.†—Herr B. Stange has investigated this subject in the case of some flowering plants, especially *Phaseolus vulgaris*, *Pisum sativum*, *Lupinus luteus*, and *Cochlearia officinalis*. He finds that in accordance with previously recorded observations on the lower plants, flowering plants can also adapt themselves to a higher degree of concentration of the substratum, and this is accompanied by an increase in the osmotic pressure within the cell. The osmotic processes are more or less connected with the action of light. In the dark the osmotic pressure is less, even with an increased concentration of the substratum.

Influence of Nutriment on the Vegetable Cell.‡—Dr. T. Bokorny gives the result of a series of experiments on the changes effected on the form and growth of the cell—chiefly *Spirogyra*—by supplying it with different nutrient media. These changes affect the form and length of the cell, the extent to which the filament branches, the position, breadth, and colour of the chlorophyll-bands, the amount of starch they contain, the proportion of proteids in the cytoplasm, and the composition of the cell-sap, especially as to the amount of tannin contained in it.

Biology of Buds.§—Dr. J. Grüss has investigated the structure of the leaf-buds in a number of trees, both evergreen and deciduous, and the functions which they perform. In many trees the parenchymatous cells of the outer covering of dormant buds serve as a reservoir for food-materials, chiefly carbohydrates. But the chief function of this covering is as a protection against excessive transpiration; the provisions for this purpose consist in an excretion of resin, and the formation of layers of cork or of a hairy coating. Protection is also afforded by the same contrivances against a sudden fall of temperature. The special structures are described in detail in a number of examples.

* Biol. Centralbl., xii. (1892) pp. 257-61.

† Bot. Ztg., i. (1892) pp. 254-9, 273-9, 292-301, 305-12, 329-33, 342-50, 363-7, 373-9, 394-400, 409-13, 429-32, 446-50.

‡ Biol. Centralbl., xii. (1892) pp. 321-30.

§ Jahrb. f. Wiss. Bot. (Pringsheim), xxiii. (1892) pp. 637-703 (4 pls.).

Development of the Buds in the Potato.*—It has long been observed that the buds in the anterior or upper half of a potato develop earlier and more rapidly than those in the posterior or lower half. M. A. Prunet states that in young potatoes the nutritive substances are distributed uniformly through the tuber; but that at a later period a flow of these substances takes place from the lower towards the upper part; so that the buds in this portion have a larger supply of food-material when they begin to germinate than have those in the lower part.

Grafting of Cruciferæ.†—M. L. Daniel finds it possible to graft successively different species of Cruciferæ upon one another, even when they belong to different genera, in a great variety of ways, viz. :—perennial or biennial on annual species, and *vice versâ*, or an aerial stem on an aerial stem, or an underground on an underground stem, and even an aerial on an underground stem. In many cases it was found that the graft influences the host-plant by imparting to it in some degree its character as to durability, i. e. whether annual, biennial, or perennial. The grafting of a portion of the descending on a portion of the ascending axis does not appear to have been accomplished before.

Regeneration of Split Roots.‡—From observations made by Herr G. Lopriore on a large number of plants, he concludes that under favourable conditions the regeneration of split roots is possible in all plants, whether herbaceous or woody. In this renewal all the tissues partake, cortex, epiderm, and vascular system. In the region which borders the incision a healing tissue is first formed, and soon afterwards in it a meristem composed of cells arranged parallel to the surface of the wound appears. From this the new tissues are again formed. The process varies in Monocotyledons and Dicotyledons, and several different types are described.

Revivification of Desiccated Plants.§—Prof. G. Bonnier concludes, from a series of experiments, that many cultivated plants may be dried up after a shorter or longer period of germination, that they may be preserved in this condition, and may again pass into a state of active development, if replaced in favourable conditions. It is the water above all, which, abandoning or combining with the protoplasm, plays the principal part in the alternations of diminished or increased vitality. The water of the membranes of grains of starch, &c., appears to play only a secondary part. In the species studied, the wheat, the pea, and the bean are those which present the phenomenon of revivification in a most advanced stage of development. When the roots or the apex of the stem do not themselves resume the state of active vitality after desiccation, the plant develops by means of new roots or by adventitious buds. Finally, if we study these plants in the course of revivification, from the point of view of the gaseous exchanges and of the disengaged heat, we find phenomena analogous to those of the germination of seeds, except that the first period (during which the relation of the exchanged gases borders on unity and in which the disengaged heat is less than

* Comptes Rendus, cxiv. (1892) pp. 1079–81.

† Tom. cit., pp. 1294–6. Cf. this Journal, *ante*, p. 67.

‡ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 76–83.

§ Rev. Gén. de Bot. (Bonnier), iv. (1892) pp. 193–201.

in the sequel) is relatively shortened. This first period of the germinative phenomena is even all the more shortened if the revivification takes place on a young plant which has been dried up in a more advanced stage of development.

Vitality of Annual Plants.*—Referring to the observations on this subject by Prof. T. Holm, Mr. T. Meehan advances the view that any annual may be made perennial by persistently destroying the flower-buds as they appear. Few plants except those which are distinctly woody have perennial parts; in tubers, rhizomes, bulbs, &c., the older portions die after new portions have been formed. The power to produce offshoots or stolons is the only real difference between annual and perennial herbaceous plants. Even in the case of those annuals which throw up only a single flower-scape, if the flower-buds are removed before they expand, and the flower-stem cut up into sections, plants may be raised which will live for many years if annually treated in the same way.

(3) Irritability.

Hygrochasy.†—Herr P. Ascherson proposes the term *hygrochastic* for those plants in which the bursting of the fruit and the dissemination of the seeds (or spores) are brought about by movements resulting from the absorption of water by the fruit or collection of fruits; *xerochastic* for those in which the same results are attained by corresponding movements resulting from desiccation. The latter is by far the more common phenomenon; but hygrochastic movements are known in *Anrstatica hierochuntica* and in some Compositæ (rose of Jericho), in *Selaginella lepidophylla*, and in the fruits of many species of *Mesembryanthemum*; in the capsules of *Zygophyllum* and *Fagonia*; in the calyx of some species of *Prunella* and *Salvia*; in the mature inflorescence of *Iberis umbellata*, &c. The two following striking instances are now recorded:—

In *Lepidium spinosum* (Cruciferæ) the ripe fruits are when dry closely adpressed to the rachis of the raceme; access of water causes the fruit-stalk to bend at an angle of about 45°, and the fruit to burst open on slight contact. The bending of the fruit-stalk is occasioned by the presence of a “dynamic tissue” capable of strong swelling on its inner side; the bursting of the capsule by a peculiar structure of the replum. In *Ammi Visnaga* (Umbelliferæ) the phenomena are precisely opposite to those in the allied *Daucus Carota*. When dry the rays of the umbel are closely curved together, but expand when moist. The cause of this movement is a strongly extensible cushion situated at the apex of the axis of the umbel between the points of departure of the secondary rays.

(4) Chemical Changes (including Respiration and Fermentation).

Function of Salts of Calcium and Magnesium.‡—Herr O. Loew has investigated experimentally the function of these two classes of salts in the vital economy, and finds an essential difference between them.

* Proc. Acad. Nat. Sci. Philadelphia, 1892, pp. 160–2. Cf. this Journal, *ante*, p. 67.

† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 94–114 (2 pls.).

‡ Flora, lxxv. (1892) pp. 368–94.
1892.

One main purpose of lime salts appears to be the removal of the poisonous oxalic acid; and it is probable that the framework of the chlorophyll-bodies and of the nucleus consists of combinations of calcium with plastin and nuclein. Magnesia is a much weaker base than lime, and its salts are more easily decomposed; hence the assimilation of nitrogen and sulphur is much more easily effected from magnesium than from calcium salts, and from these more easily than from potassium or sodium salts. One of the useful purposes served by magnesium salts is the formation of magnesium phosphate, which gives off with great readiness a portion of its phosphoric acid, and thus greatly facilitates the formation of nuclein, plastin, and lecithin. Neutral oxalates are poisonous to the higher plants and to algæ, but not to the lower fungi. When calcium salts are not present, magnesium salts are poisonous to all chlorophyllaceous plants; but, when accompanied by a sufficient quantity of calcium salts, they display no trace of this poisonous property, and perform their nutritive function as a carrier of phosphoric acid.

γ. General.

Myrmecophilous Oak-galls.*—According to Prof. E. Ráthay, the galls of *Cynips calycis*, produced on *Quercus pedunculata*, attract numbers of small ants in consequence of their viscid secretion, and he believes that they are in this way advantageous to the tree, the ants killing quantities of caterpillars and others of its natural enemies. The value of this protection is illustrated by the fact that the inhabitants of a single ant's nest may destroy in one day upwards of 100,000 insects.

Micro-organisms and Insectivorous Plants.†—From observations made on *Pinguicula vulgaris*, *Drosera rotundifolia* and *longifolia*, *Dionæa muscipula*, and *Nepenthes Mastersi*, Herr N. Tischutkin concludes that the solution of albumen by their sap is not due to any peptonizing substance contained in solution in it, but to the activity of the micro-organisms, always present in the sap of the mature plant, and derived from the air, the bodies of insects, &c. For the development of these microbes the peculiar secretion of insectivorous plants furnishes a very favourable pabulum. The secretion of young unopened pitchers of *Nepenthes* has no peptonizing property.

Nectar of Poinsettia.‡—According to Mr. W. E. Stone, the nectar of *Poinsettia pulcherrima* consists approximately of cane-sugar 11·23 per cent., glucose 57·79 per cent., water 30·98 per cent.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Male Prothallium of the Rhizocarpeæ.§—Herr W. Beliajeff has studied the male prothallium which proceeds from the microspore in the genera *Salvinia*, *Azolla*, *Marsilea*, and *Pilularia*. Its structure and

* SB. K. K. Zool.-Bot. Gesell. Wien, xli. (1891) pp. 88-93.

† Arb. St Petersburg Naturf.-Gesell. (Bot.), 1891, pp. 33-7. See Bot. Centralbl., l. (1892) p. 304. ‡ Bot. Gazette, xvii. (1892) pp. 192-3.

§ 'Ueber d. männlichen Prothallien d. Rhizocarpeen,' Warschau, 1890, 86 pp. and 5 pls. See Bot. Centralbl., l. (1892) p. 327 (3 figs.).

development are evidence of the close relationship of the genera of Rhizocarpeæ with one another, and that both in the divisions of the prothallium and in the structure of the antherid itself. Between the two genera of Marsileaceæ the resemblance is much closer than between the two genera of Salviniaceæ; and the facts appear to indicate that the former is the lower and older family.

In *Salvinia* the prothallium is from the first dorsiventral. It first of all divides by two septa, of which one is nearly horizontal and the other oblique, into three segments. Of these the lowest, which is somewhat larger than the other two together, undergoes no further alteration except the cutting off of a very small lenticular cell at its base. The middle and upper segment each divide into three by two successive, nearly parallel septa. In each segment the central cell is the antherid, the two which bound it on each side are barren. The mature prothallium therefore consists of eight cells, of which six are barren, the other two being two antherids completely separated from one another. The antherid finally breaks up into four antherozoid mother-cells.

In *Azolla* the first processes of division correspond to those in *Salvinia*. The prothallium divides into three segments, and from the lowest of these a small lenticular cell is cut off. But the uppermost segment undergoes no further division, while the central segment divides by successive divisions into a large central and four sterile cells. The mature prothallium consists of a single antherid and seven barren cells. The antherid breaks up into eight antherozoid mother-cells.

In *Marsilea* and *Pilularia* the processes are far more difficult to follow in consequence of the hard dark epispore. The prothallium of *Marsilea* is nearly spherical, and its dorsiventrality greatly obscured. The mature prothallium consists of eight sterile cells, and two antherids completely separated from one another; in each antherid 16 antherozoid mother-cells are produced. In *Pilularia* the processes appear to be similar as far as they can be followed out.

A comparison with the development of the prothallium in Filicinæ, especially in the Hymenophyllaceæ, leads the author to the conclusion that the small cell which is cut off from the lowermost primary segment in the Rhizocarpeæ is a rudimentary rhizoid.

Muscineæ.

Braithwaite's British Moss Flora.—Part xiv. of this work continues the description of the Bryaceæ. It deals with the genera *Pohlia* (twelve species), *Epipterygium* (one species), *Plagiobryum* (two species), and commences the large genus *Bryum*, which is divided into three sections—*Sclerodontium* (two species), *Cladodium* (nine species), and *Eubryum* (twenty-four species). The part is illustrated by six excellent plates.

Algæ.

Cultivation of Marine Algæ.*—Dr. F. Noll explains the contrivances by which he has been successful in growing sea-weeds in aquaria. Besides attention to the composition of the water, constant change is necessary, in order that the plant may be supplied with a sufficient

* Flora, lxxv. (1892) pp. 281-301. Cf. this Journal, *ante*, p. 396.

quantity of the mineral ingredients, which are present in very small proportions in sea-water. A complete aeration is also necessary to the healthy growth of the plants. Although iodine is present in very large quantities in the ash of many seaweeds, we are at present entirely ignorant of the part which it plays in their vital economy.

Adaptation of Fresh-water Algæ to Salt-water.*—Herr A. Richter has undertaken a series of experiments with the view of determining to what extent freshwater algæ can thrive in solutions of sodium chloride varying in concentration between 0·5 and 8 per cent. He finds that a number of species, belonging to a great variety of classes, Cyanophyceæ, Diatomaceæ, Chlorophyceæ, and Characeæ, can adapt themselves to these changed conditions, in some cases even continuing to assimilate, to divide, and to produce zoospores. The higher the organization of the alga, the less, as a general rule, is its power of adaptation; *Chara*, *Edogonium*, *Vaucheria*, and *Spirogyra* have less capacity in this way than *Oscillaria*, *Chlorella*, *Stichococcus*, and *Tetraspora*. In all cases an increase in the size of the cells was observed, at first proportional to the degree of concentration. When the concentration was high, this was accompanied by malformation of the cells and by the conversion of the chlorophyll into a yellow or brown substance. The starch is at first consumed, but is again formed when the adaptation is more complete.

Chylocladiæ.†—Herr P. Hauptfleisch discusses the structure and life-history of the three genera *Chylocladia*, *Champia*, and *Lomentaria*, which make up the family Chylocladiæ of the Rhodymeniaceæ. The following species are especially described—*Chylocladia kaliformis*, *C. ovalis*, *Champia lumbricalis*, *C. parvula*, *Lomentaria articulata*, *L. clavellosa*. All three genera are maintained, but the species are distributed among them in a different way from that proposed by previous authorities. The structure of the fructification is exceedingly similar in all three genera. The vegetative structure also differs but little. In neither of the three is a single apical cell to be detected. The distinctive characters given by the author are the following:—in *Lomentaria* the thallus is without diaphragms, the tetraspores are placed in depressions; in the two other genera the thallus has diaphragms and the tetraspores are scattered; in *Chylocladia* the lobes of the cystocarps are unicellular; in *Champia* they are multicellular. The genus *Gastrochlonium* must be sunk in *Chylocladia*. *Chrysymenia* and *Bindera* belong also to the Rhodymeniaceæ; but are distinguished from the Chylocladiæ by the absence of medullary filaments.

Cystocarps of Catenella Opuntia.‡—Mr. R. J. Harvey Gibson has studied the structure of this seaweed, including that of the hitherto unknown cystocarp. Protoplasmic continuity exists between all the younger cells of the frond; but later this seems to become interrupted by the growth of plug-like thickenings. Antherids and procarps are borne on the same plant, and usually near together. The mode of formation of the cystocarp differs in some points from the usual type in Florideæ. Although the trichophoric systems are numerous, only

* Flora, lxxv. (1892) pp. 4-56 (2 pls.).

† Tom. cit., pp. 307-67 (2 pls.).

‡ Journ. Linn. Soc. (Bot.) xxix. (1892) pp. 68-76 (2 pls.).

one cystocarp is produced. Fertilization is effected by the fusion of the pollinoids with the trichogyne; but the complete process is an indirect one. The carpospores are not produced from the cells immediately beneath the trichogyne, but are developed in chains from the medullary network of cells continuous with that from which the trichophoric cells and the trichogyne arise. Each trichogyne is in communication, by means of the trichophoric apparatus, which consists of from one to three cells, with the subcortical web of hyphæ; and this is in its turn continuous with the longer and larger medullary cells. The development of the carpospores commences only after fertilization; but not unfrequently a number of subsidiary vegetative cells are formed round the trichophore, even before fertilization, and these are readily mistaken for carpospores.

Cystocarps of *Callophyllis* and *Rhodymenia*.*—Mr. J. B. Carruthers describes the cystocarps in several seaweeds which he refers to the genera *Callophyllis* and *Rhodymenia*. The details of the development of the fruit of *Callophyllis obtusifolia* do not agree with Agardh's account of the structure of that genus, but rather with the mode of development which Bornet has described for the cystocarps of *Gymnogongrus* and *Callymenia*, and Schmitz for those of *Gigartina* and *Chondrus*.

Fossil Corallinaceæ and Codiaceæ.†—According to Herr A. Rothpletz the fossil species of *Lithothamnion* cannot be safely determined by the size of the cells, which is variable. The mode of formation of the tetraspores furnishes a better character for their arrangement under three groups, viz. (1) tetraspores placed singly on zonal areas in the calcified tissue (*L. ceanoticum* sp. n., *turonicum* sp. n., *gosaviense* sp. n., *nummuliticum*, *torulosum*; (2) tetraspores placed singly in small lumps in the calcified tissue (*L. ruganum* sp. n.); (3) tetraspores collected into conceptacles outside the tissue (*L. racemus*). Of these the first is much the oldest group.

The author further describes a new genus and species *Sphærocodium Bornemanni* belonging to the Codiaceæ. The thallus spreads over foreign bodies, especially the stalks of crinoids and fragments of mussel-shells. Like *Codium* it forms terminal sacs and lateral swellings (sporangies); but the sporangies are globular. *Giovanella*, hitherto referred to the Foraminifera, is a genus of Codiaceæ, nearly allied to *Sphærocodium*.

New Australian Freshwater Algæ.‡—Prof. M. Moebius describes a large collection of freshwater algæ from Brisbane, including several new species. Among the more interesting additions are two new species of *Coleochaete*, *C. Baileyi* and *conchata*. In the former zoospores are produced in all the cells of the erect branches. The oogones appear to detach themselves very readily from the thallus. The latter species has a very peculiar cortication of the oogones.

Muciferous tissue of the Laminariaceæ.§—M. L. Guignard has investigated the structure and development of the mucus-canals or

* Journ. Linn. Soc. (Bot.) xxix. (1892) pp. 77-86 (1 pl.).

† Zeitschr. Deutsch. Geol. Gesell., xliii. (1891) pp. 295-322 (3 pls.). See Bot. Centralbl., l. (1892) p. 391.

‡ Flora, lxxv. (1892) pp. 421-50 (22 figs.).

§ Ann. Sci. Nat. (Bot.), xv. (1892) pp. 1-46 (20 figs.); and Comptes Rendus, cxiv. (1892) pp. 139-41.

passages in the Laminariaceæ, taking as a favourable type *Laminaria Cloustoni*. He recommends for the fixing of the tissues a solution of chrome-alum in sea-water, and the mucilage can then be coloured by a variety of staining-reagents,—dahlia, methyl-violet, gentian-violet, or especially methyl-green acidulated by acetic acid.

The only part of the frond where the muciferous canals are wanting is the generating zone between the perennial stipe and the annual lamina; and it is at this point that the origin and the development of the canals which are formed on each side of it can be especially studied. They can be first detected in the form of lenticular cavities in the radial walls of cells belonging to the epidermal layer, which rapidly become filled with mucilage. These cavities are pushed into the cortical tissue by the growth and separation of the epidermal cells, and small cells containing a large nucleus buried in dense protoplasm, and presenting the characters of secreting cells, then become separated from their base. The mucilage-cavities then put out through the thickness of the cell-walls branches which enter into communication with one another, and thus form a connected net-work, on one side in the stipe, on the other side in the lamina. This net-work advances towards the surface, and even pushes apart the epidermal cells, but never breaks through the cuticle. They, therefore, never discharge their mucilage outside the frond.

Special descriptions are given of the structure and arrangement of the muciferous canals in various species of *Laminaria*, *Ecklonia*, *Alaria*, *Macrocystis*, *Lessonia*, and other genera; and the author concludes that their presence in the stipe only, or in the lamina only, or in both, or their entire absence, may be useful in furnishing specific, but not generic characters.

Splachnidiaceæ, a new order of Algæ.*—Miss M. O. Mitchell and Miss F. G. Whitting give a full description of *Splachnidium rugosum*, a seaweed from the Cape of Good Hope, hitherto referred to the Fucaceæ. A close examination of the alleged oogones shows that they differ from the structure of this organ in the Fucaceæ in several important points, viz. in the very large number and small size of the "oospheres" (500-600) into which their contents break up; in the absence of a pedicel; and in the absence of an inner membrane within the wall of the "oogone." That they cannot be antherids is also shown by the very large number of "antherozoids"; by the large size of the "antherid"; and by their production directly from the cells lining the conceptacle. The authors regard them, on the other hand, as sporanges containing either zoospores which germinate directly, or conjugating zoogametes. The arguments in favour of this view are the large size of the sporange, its unilocular nature, and the persistence of the empty spore-cases. On these characters the authors propose to establish the new order SPLACHNIDIACEÆ, belonging to the Phæophyceæ, but affording a connecting link between the Laminariaceæ and the Fucaceæ. Its diagnosis will be as follows:—Algæ olivaceæ, per fulcrum discoideum e fibris radicalibus coalescentibus formatum, substrato affixæ, frondibus ramosis, externe e cellulis parenchymatibus, interne e filis inter stratum currentibus, compositis; sporæ in sporangiis clavatis inclusæ, inter paranemata

* Phycol. Mem. (Murray), i. (1892) pp. 1-9 (3 pls.).

simplicia articulata in scaphidiis infra superficiem excavatis, per totam frondem dispersis, collectæ.

New Genera of Algæ.*—In a collection of freshwater Algæ found growing on human skulls obtained from the Melanesian Islands, Prof. A. Borzi finds a large number of new species and the following four new genera:—

Loriella, a genus of Stigonemaceæ. Thallus exiguus, cæspitoso-flocosus, e pilis rigidis fragilibus repetite dichotome ramosis dense aggregato-fastigiatis constitutus; vegetatio terminalis, definita, cellulæ apicales repetita bipartitione longitudinali in ramulos evolutæ, ramuli breves, recti, in statu juvenali basi vagina communi inclusi, deinde omnino liberi et erecto-patentes; vaginæ sat crassæ, granulis calcareis baculiformibus dense farctæ et fragilissimæ; cellulæ elliptico-depressæ aut subquadratæ; heterocystæ solitariæ ad apices vel ad basin ramulorum, sphaerico-depressæ, cellulas vegetativas æquantes; sporæ globosæ aut ovales vel ellipticæ, articulis vegetativis paullo majores, multiseriatae, olivaceo-fuscæ, episporio lævi, tenui.

Entodesmis, a genus of Phæophyceæ. Cellulæ oblongæ aut ellipticæ, utroque polo obtusato-rotundatæ, 4–8–16 intra integumentum commune gelatinosum achroum amplum lateraliter approximatae, et familias tabulatas, cubicas aut fasciæformes liberas, v. in stratum indefinitum muco amorpho involutas, effigientes; chromatophoro unico parietali laminæ-formi; divisio vegetativa sæpius ad unam directionem, nonnunquam ad duas v. tres directiones; multiplicatio agamica zoosporis solitariis v. binis intra cellulas vegetativas omnino immutatas evolutis, ciliis duobus inæqualibus oculo laterali rubro instructis.

Pleurothamnion, a genus of Ctenocladiceæ. Thallus e filamentis articulatis, crebre ramosis, sæpe calce induratis, et in cæspitulos densissimos pulviniformes aggregatis, constitutus; articuli vegetativi omnes ramigeri; chromatophoro unico amplo parietali, pyrenoide amyliifero instructo; ramuli primarii decumbentes, secundarii ascendentes v. erecti; ultimi omnes ex articulo singulo sursum egredientes et regulariter secundatim dispositi; zoosporangia ovalia, obovalia, v. ellipsoidea, ex articularum vegetativorum repetita bipartitione transversa etiamque longitudinali procedentia; zoosporæ 4–8 in quoque zoosporangio, ovales, rostro brevi, ciliis binis, oculo rubro laterali præditæ; articuli vegetativi in statum palmelloideum transeuntes; status sexualis ignotus.

Polychloris, a genus of Botrydiaceæ. Algæ eximie symbioticæ, intra corpus Amœbæ vigentes, cellulis globosis v. mutua pressione angulato-rotundatis, membrana tenui lævi, chromatophoris numerosis minutis disciformibus, pyrenoidibus carentibus; divisio vegetativa ad tres directiones alternans; cellulæ omnis generationis conformes, aliæ in statu vegetativo perdurantes, aliæ zoosporangia efficientes; zoosporæ 8–16 in quoque zoosporangio, per porum lateralem libere examinantes, ovales, rostro brevi hyalino, cilio unico et chromatophoris 3-paucis instructæ; cystæ cellulis vegetativis conformes, sed membrana crassiuscula donatæ.

Abnormal Growth of Spirogyra.†—Miss Emily L. Gregory describes a malformation produced in cells of a *Spirogyra*, apparently by the

* La Nuova Notarisia, iii. (1892) pp. 35–53.

† Bull. Terrey Bot. Club, xix. (1892) pp. 75–9 (1 pl.).

attacks of a parasitic green monad. The filaments were bent and branched in a variety of ways, and the chlorophyll-bands had undergone more or less disintegration. The monads escaped in the form of small green spherical bodies, which were at first quiescent, but afterwards went through amœboid movements, finally again becoming spherical and quiescent.

Irish Freshwater Algæ.*—Mr. W. West describes a remarkably rich collection of Freshwater Algæ from the West of Ireland. It comprises 316 species of Desmidiaceæ, 128 of Diatomaceæ, and 144 belonging to other orders, besides a large number of subspecies, varieties, and forms. Thirty-four species are new to science, and a considerable number of others have not previously been observed in Britain.

Dermatomeris, a new genus of Ulvaceæ.†—Herr P. F. Reinsch describes a collection of fresh-water algæ from S. Georgia, obtained in the German Polar Expedition. Among them are several new species of *Sorastrum*, *Celastrum*, *Prasiola*, *Cosmarium*, *Ulothrix*, *Rhizoclonium*, *Vaucheria*, &c., and a new genus of Ulvaceæ, *Dermatomeris*, nearly allied to *Schizomeris*, with the following diagnosis:—Thallus foliaceo-membranaceus, substantia coriaceo-gelatinosa, basi angustata callosa insidens. Cellulæ frondis dilatatæ rotundatæ et subangulosæ, spatiis latioribus hyalinis disjunctæ, in octades dispositæ (in sectione thalli in tetrades et thalli horizontaliter visæ in tetrades dispositæ), in sectione thalli quadri-seriatæ. Cellulæ basis angustatæ dilatatæ in familiis octo-cellulares usque 12-cellulares, globulosas, absque ordine dispositas dispositæ. Several species of Chytridiaceæ and Saprolegniaceæ were also observed endophytic in cells of *Cosmarium* and *Staurastrum*.

Zoogametes of Enteromorpha.‡—Mr. R. J. Harvey Gibson describes the mode of escape and conjugation of the zoogametes of *Enteromorpha compressa*. They always escape singly through an aperture in the wall of the gametange. The conjugation always commences with the fusion of the pointed ends, and the process appears to take over an hour. In no case were gametes from the same cell seen to conjugate.

Cymopolia, Neomeris, and Bornetella.§—Graf zu Solms-Laubach confirms most of Cramer's observations on the two latter of these genera of Dasycladaceæ. In the single large spore which fills up the sporangium of *Neomeris annulata* he states that the basal end exhibits a flat circular furrow by which a slightly projecting calotte is separated, corresponding to the cap in the spore of *Acetabularia*. The mode of development of *Neomeris* corresponds, in all probability, to that of *Acetabularia*; gametes are formed from the contents of the spore after the sporangium has become freed from its calcareous incrustation; these gametes no doubt conjugate, and the zygote gives birth at first to a simple unbranched filament. The structure of *Cymopolia barbata* indicates also that the same processes take place there also. The sporangium puts out two green protuberances with blunt ends, but the gametange appears to be some-

* Journ. Linn. Soc. (Bot.), xxix. (1892) pp. 103-216 (7 pls.).

† Sep. Abdr. aus Ergebn. d. Deutsch. Polar-Expeditionen, ii., 37 pp. and 4 pls.

‡ Journ. of Bot., xxx. (1892) pp. 103-4.

§ Ann. Jard. Bot. Buitenzorg, xi. (1892) pp. 61-97 (3 pls.). Cf. this Journal, 1891, p. 75.

times produced non-sexually without the previous formation of gametes. A new species, *Cymopolia van Bossei*, is described from the Dutch E. Indies, the early stages of which closely resemble those of *Neomeris*.

Of *Bornetella* a new species, *B. oligospora*, is also described. The sporangium contains only a comparatively small number of spores, from 6 to 14. The cap of the spore is here more conspicuous than in *Neomeris*.

Ochlochæte and Phæophila.*—Prof. A. Hansgirg sinks Hauck's genus of Chlorophyceæ *Phæophila* in *Ochlochæte*. It is entirely a marine genus, occurring on other seaweeds or on calcareous shells.

Fungi.

Growth of Fungus-hyphæ.†—Herr M. O. Reinhardt gives an elaborate dissertation on the mode of growth of the hyphæ of fungi, and the influence on it of various external agents. The observations were made chiefly on the mycelium of *Peziza sclerotiorum*, *Trifoliorum*, *Fuckeliana*, and *tuberosa*. The growth in length of the hyphæ does not take place by any means regularly, but rather spasmodically. Examined in a hanging drop, the form of the growing apex is found to be nearly that of a hemisphere; a firm membrane is always present at the apex, though very difficult to detect.

The growth of the mycelium of *Peziza* is affected in different ways by other fungi, according to the species. It is excited to produce peculiar growth-forms, not only by *Mucor*, *Penicillium*, and *Aspergillus*, but also by other species of *Peziza*. The filaments of all species excrete oxalic acid; and, since this is highly poisonous to *Peziza*, they exercise a prejudicial effect on one another's growth. The destruction of the living cells of the host-plant is effected by an enzyme; and it is probable that each species produces its own special enzyme; hence the reason why, in nature, we find each species only on a special host-plant, while the same rule does not apply to their saprophytic culture. The hyphæ must first attain a sufficient development through saprophytic nourishment before they can produce the enzyme to destroy the living cells of the host-plant.

The author contests the view that the apical growth of fungus-hyphæ takes place by surface-growth through stretching; the observed facts are much more in favour of the view of a growth by intussusception.

Similar observations made by the author on the growth of root-hairs led to very similar conclusions.

Fatty matters in Fungi.‡—M. E. Gérard has investigated the nature of the fatty matters in two Hymenomycetous Fungi, *Lactarius vellereus* and *piperatus*. The process is described of first extracting the fatty substances by boiling alcohol and then purifying. In both species they were found to consist of a mixture of volatile and non-volatile fatty acids, cholesterolin, and lecithin. The acids are oleic and stearic acid, both free and as glycerin-compounds, formic, acetic, and butyric.

* Oesterr. Bot. Zeitschr., xlii. (1892) pp. 199-201.

† Jahrb. f. Wiss. Bot. (Pringsheim) xxiii. (1892) pp. 479-566 (4 pls.).

‡ Bull. Soc. Mycol. de France, vi. (1890) pp. 116-34. See Bot. Centralbl., l. (1892) p. 110.

The cholesterins are apparently different in the two species, and are clearly distinct from animal cholesterin.

Nuclei in the Mucorini.*—In *Phycomyces nitens*, *Thamnidium elegans*, and *Chaetocladium Freseii*, M. A. De Weve finds minute rounded or fusiform bodies, immersed in the protoplasm, not more than 1–2 μ in length, which he regards as nuclei. In the fertile hyphæ there are several of these bodies, often a large number; in the spores only one; they multiply by division. In *Rhizopus nigricans* they occur in the “stolons.” In *Pilobolus crystallinus* the results were less decisive. The best staining reagent for these minute nuclei was found to be picronigrosin.

Syncephalastrum elegans.†—M. E. Marchal describes this new species of *Syncephalastrum* (Mucorini) found on the bark of the stem of *Cinchona rubra*. It presents an interesting connecting link between the Mucoreæ and the Syncephalidæ, the structure of the mycele and the arrangement of the sporanges being those of typical Mucoreæ, while the form of the sporanges, linear and cylindrical, resembles that of *Syncephalis*.

Cultivation of Rhizopus nigricans.‡—M. E. De Weve details the results of a long series of experiments on the culture of this fungus, describing the changes induced by cultivation in different media and by differences in the external conditions. The zygospores are formed only under unfavourable conditions of growth, and the author draws from his experiments the conclusion that this fungus has lost the power of forming these organs except under special conditions, and that there are races of it in which this faculty is altogether suppressed.

New Genera of Hyphomycetes.§—Mr. A. P. Morgan describes the two following new genera of Mucedineæ:—

Cylindrocladium. Sterile hyphæ creeping, branched; fertile hyphæ erect, forked or trichotomously branched, the sporophores in pairs or threes at the extremities of the branchlets and cymosely arranged; spores solitary, cylindrical, 1-septate, hyaline. *C. scoparium*, on an old pod of *Gleditschia triacanthos*.

Synthetospora. Hyphæ procumbent, branched, intricate, sending out short lateral fertile branchlets, which produce the spores at the apex; spores lobed, each consisting of a large opaque central cell with several smaller hyaline cells sunk partly into its surface. A compound *Mycogone*. *S. electa*, on the hymenial surface of a *Peziza*.

Monograph of Dematophora.||—According to M. P. Viala, the disease of the vine and of other cultivated and wild plants known as *pourridié*, may be produced by a variety of fungi—*Agaricus melleus*, *Dematophora necatrix*, *Vibrissæ hypogea*, and the mycele of *Psathyrella ampelina*. Of these, by far the most destructive is the *Dematophora*.

Dematophora necatrix is a very polymorphic fungus, occurring in as many as six mycelial forms, viz. as a white external mycele; as a

* Bull. Soc. Bot. Belg., xxx. (1892) pp. 191–5 (1 pl.).

† Bull. Soc. Belge Microscopie, xviii. (1892) pp. 124–32 (4 figs.).

‡ Tom. cit., pp. 133–52.

§ Bot. Gazette, xvii. (1892) pp. 190–2 (2 figs.).

|| ‘Monographie du pourridié (Dematophora),’ Paris, 1891. See Bull. Soc. Bot. France, xxxix. (1892) Rev. Bibl., p. 9.

similar mycele turned brown; as external rhizoidal strings, formed from a condensation of the first form; as external rhizomorphs (*Rhizomorpha fragilis* var. *subterranea*); the same more completely organized; as subcortical rhizomorphs (*R. fragilis* var. *subcorticalis*); and as an internal mycele. The reproductive forms are again five in number, viz.:—(1) chlamydospores on the white or brown mycele (very rare); (2) sclerotes on the internal mycele; (3) conidiiferous filaments springing from the sclerotes or from the floccose mycele; (4) pycnids; (5) ascosporous fructification or peritheces. All these forms are very rare in nature, but may be produced in cultivation. The fungus is equally capable of carrying on a parasitic and a saprophytic existence, and propagates, in nature, almost entirely by its mycele.

The distinction between *D. necatrix* and *D. glomerata* is pointed out; and the life-history of the other fungi which cause "pourridiè" is described.

Parasites of the Vine.*—Sig. F. Cavara describes in detail the life-history of *Peronospora viticola* and of *Coniothyrium Diplodiella*, and the nature of the diseases which they cause in the vine. Of the latter species, *Phoma Briosii* and *P. baccæ* are only immature forms; as is perhaps *Greeneria fuliginea*.

The following new Italian fungus-parasites of the vine are described:—Among Pyrenomycetes *Physalospora baccæ* sp. n.; among Sphæröpsidæ *Phoma lenticularis* sp. n.; among Melanconicæ *Glæosporium Physalosporæ*, *Pestalozzia viticola*, *Alternaria vitis*, and *Napicladium pusillum* spp. nn.; also *Briosia ampelophaga* gen. et sp. n. The new genus *Briosia* is placed among the Stilbæ, near to *Heydenia*, with the following diagnosis:—Stroma verticale, cylindraceum, stipitatum, hyphis fasciculatis compositum, apice capitulum compactum efformans; conidia globosa, typice catenulata, fusca, aerogena. Among Tuberculariæ *Tubercularia acinorum* is a new species.

Sclerotinia Rhododendri.†—Herr W. Wahrlich gives a full description of the structure and life-history of this fungus, which is parasitic on the capsules of the alpine species of *Rhododendron*. The asci contain eight ovoid ascospores, and the fungus is propagated also by sclerotes.

Bitter-rot of American Grapes.‡—According to Sig. F. Cavara, the characters of *Greeneria fuliginea*, the fungus which produces the "bitter-rot" of American grapes, are identical with those of *Melanconium*, under which genus it should henceforth be placed. It is not therefore, as he previously supposed, identical with *Coniothyrium Diplodiella* and *Tubercularia acinorum*.

Root-brown of Lupins.§—Herr W. Zopf describes this new disease of lupins, caused by the attacks of *Thielavia basicola*, a fungus belonging to the Pyrenomycetes, and to the Perisporiaceæ. Besides two kinds

* Atti Ist. Bot. Univ. Pavia, i. pp. 293-323. See Bot. Centralbl., 1892, Beih., p. 146.

† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 68-72 (1 pl.).

‡ Atti Ist. Bot. Univ. Pavia, i. pp. 359-62. See Bot. Centralbl., 1892, Beih., p. 150.

§ Zeitschr. f. Pflanzenkrankheiten, i. (1892) pp. 72-6. See Bot. Centralbl., i. (1892) p. 213.

of conids, very small ascigerous fructifications are produced, spherical and closed on all sides, within which are small ovoid asci, each containing eight ascospores. It is distinguished from the *Erysipheæ* by the mycele penetrating into the tissue of the host.

“**Hyphopodes**” of *Meliola*.* — M. A. Gaillard describes peculiar swollen, stalked or sessile, alternate or opposite, appendages, on the filaments of the mycele of *Meliola microspora*, which bears the peritheces. To these structures he applies the term “hyphopodes.” They are of two kinds, mucronate and capitate. He states that the latter are undeveloped peritheces, the former arrested branches of the mycele. He considers that the occurrence of these structures confirms the view that all the hyphæ are of equal morphological value, and that the various forms which they assume are adaptations to external conditions. He further asserts the incorrectness of the ordinary view that the peritheces are the result of an interweaving of the mycelial hyphæ. In *M. coronata* and *tonkinensis* he finds peritheces which have reverted to their vegetative condition, and have remained sterile; they had put out from their surface a large number of vegetative filaments which bear capitate hyphopodes.

Sclerotium hydrophilum.†—The fungus to which this provisional name has been given occurs as a small black or dark yellow-brown sclerote springing from a delicate mycele, on various freshwater plants. Herr W. Rothert has investigated its structure and life-history, and finds it to differ from most other sclerotes in its central part being white and of a loose texture, with air-containing spaces. The cell-contents of this central portion consists of glycogen, and each cell usually contains only a single nucleus; adjacent hyphæ very frequently coalesce. The sclerotes germinate readily, and retain their power of germination for a long period. The mode of life of the fungus is saprophytic and apparently never parasitic. No other mode of propagation was observed, the formation of spores of any kind being apparently entirely suppressed.

Biology of Lichens.‡—M. H. Jumelle goes into further details respecting his experiments on the gaseous interchange in lichens, and the influence of external conditions on their growth. He concludes that in all lichens, at least under favourable conditions, the energy of assimilation can, in the light, exceed that of respiration; the algal constituent being apparently able to obtain a sufficient quantity of carbon from the atmosphere, independently of the substratum. In the dark, on the other hand, the volume of carbon dioxide produced is always less than that of oxygen absorbed, the value of the proportion $\frac{\text{CO}_2}{\text{O}}$ being uniformly about 0·8, or nearly that which occurs in fungi generally.

All lichens have the property of becoming desiccated without

* Bull. Soc. Mycol. France, vii. (1891) pp. 99 *et seq.*, 151 *et seq.* See Bot. Centralbl., 1892, Beih., p. 163. Cf. this Journal, *ante*, p. 79.

† Bot. Ztg., l. (1892) pp. 321-3, 337-42, 357-63, 380-4, 389-94, 405-9, 425-9, 441-6, 457-62 (1 pl.).

‡ Rev. Gén. de Bot. (Bonnier), iv. (1892) pp. 56-64, 103-13, 159-75, 220-31, 259-72, 305-20 (3 pls.). Cf. this Journal, 1891, p. 634.

perishing, owing to the absence in them of any water of constitution ; their moisture is always regulated by that of the substratum. In the dry state, or that of latent life, all the physiological processes proceed with great sluggishness. There is for each species an optimum of moisture, complete saturation not being the most favourable condition for the vital processes. The most favourable temperature is in general about 35° C. The injurious effect of too high a temperature appears to operate only on the process of assimilation, or rather, on the chlorophyll ; the protoplasm remains unaffected, and normal respiration proceeds even when assimilation has ceased. Low temperatures do not prevent the activity of respiration. Even at - 10° C. the process may be distinctly perceived.

Thallus of Calcareous Lichens.*—Herr E. Bachmann divides calcareous lichens into epilithic and endolithic. In the former the thallus is external to the calcareous substratum, and is differentiated into a cortical, a gonidial, and a medullary layer, the rhizoidal hyphæ alone penetrating the substratum ; in the latter not only the rhizoidal, but also the gonidial and cortical layers are completely buried in the substratum. Even the apothecies are first formed within it, and only break through the calcareous layer after they have attained a certain size. The algal cells of calcareous lichens are always collected into groups of various forms, either in roundish clumps or in small-celled rows. Each group of gonids is completely surrounded on all sides by a web of mycelial hyphæ ; they may or may not contain oil. The cortical zone of endolithic calcareous lichens is always composed of two kinds of hyphæ, distinct, or collected into balls. The rhizoidal portion consists of a web of hyphæ, denser towards the surface, looser within ; spheroidal cells occur in most species. The rhizoidal portion of epilithic calcareous lichens resembles in all points that of the endolithic, and usually also contains spheroidal cells, and occasionally a few scattered gonids. The observations were made on fourteen species of endolithic, and five of epilithic lichens.

In contrast to the calcareous, siliceous lichens have a very strongly developed thallus ; but, on the other hand, the rhizoidal portion is less developed.

Siphulastrum.†—Sig. A. Jatta has studied this alpine genus of lichens from Terra del Fuego, and considers that it belongs to the Siphulei, differing from the other genera of this family in having a cyanophyceous alga-constituent (*Scytonema*), and specially adapted by its habit for an alpine habitat. In the complete absence of apothecies, the following is proposed as a diagnosis of the genus:—Thallus dendroideus, ramosus, v. dichotome divisus ; rami firmi, plus minusve teretes, undique corticati, aggregati, tantum ad apices ochroleuci, inferne ustulato-nigri ; hyphæ densæ, contortæ, breviter articulatæ, haud longitudinales ; gonidia scytonemea ; apothecia ignota.

New Marine Lichen.‡—Mr. G. Masee describes a new marine lichen, *Verrucaria lætevirens*, found on smooth rocks between tide-marks on both coasts of Scotland.

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 30-7 (1 pl.).

† Bull. Soc. Bot. Ital., i. (1892) pp. 246-50.

‡ Journ. of Bot., xxx. (1892) pp. 193-4 (1 pl.).

Diorchidium.*—An examination of the various species of this alleged genus of Uredineæ has convinced Herr P. Dietel that its generic distinction from *Puccinia* cannot be maintained, and that the oblique position of the two-celled spores is an adaptation for the easy detachment of the spores from the nutrient substratum. In *D. pallidum* the mode of development of the spores differs materially from that of the other species, and the author proposes it as the type of a new genus *Sphenospora*.

Herr P. Magnus † dissents in some points from Dietel's conclusions. He considers the structure of the teleutospores to present a valid distinction between *Puccinia* and *Diorchidium*, to which latter genus he refers *P. lateripes*. *Diorchidium Steudneri*, on the other hand, belongs rather to *Uropyxis*, as also does *Puccinia mirabilissima*.

Frankia.‡—Prof. G. F. Atkinson finds the European *Frankia Alni* infesting galls on the roots of *Alnus serrulata* in America, and a new species *F. Ceanothi* on root-galls of *Ceanothus americanus*. When the cell-protoplasm of the host is permeated by the very fine hyphæ of the attacking fungus, the whole has a close resemblance to a plasmode. Whether these organisms are symbiotic or not, he was unable to determine.

Nuclei of the Hymenomyces.§—Mr. H. Wager describes the structure of the nuclei in the basids of *Agaricus stercorarius*, and the changes which take place in them. The young basid contains two nuclei, which pass into it from the hymenial hyphæ. At an early period these unite into a single nucleus, which is at first placed near the centre of the basid, and afterwards moves to its apical portion. The structure of the nuclei is similar to that of the higher plants; they vary greatly in size. Soon after the nucleus has taken up its position near the apex of the basid, and before the appearance of the sterigmas, it begins to divide, first into two and then into four. These four nuclei now move to the base of the basid, and then again to its apex, each occupying a position near the base of a sterigma; their passage into the spores was not observed. The spores do not appear to contain a nucleus during their early stages, but when mature they contain two.

Conids of Hydnum.||—M. J. de Seynes describes a condition of *Hydnum coralloides* in which the subhymenial filaments produce small thick-walled conids instead of basids. They occur in masses or chains, and resemble those of *Polyporus biennis*.

Conidiiferous Polyporus.¶—M. N. Patouillard describes another example of a conidiiferous *Polyporus*, in a new species *P. bambusinus*, growing on bamboos in Tonquin, the tubes of which bear neither basids

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 57–62 (1 fig.). Cf. this Journal, 1891, p. 783.

† Tom. cit., pp. 192–5.

‡ Bull. Torrey Bot. Club, xix. (1892) pp. 171–7 (1 pl.). Cf. this Journal, 1891, p. 384.

§ Ann. of Bot., vi. (1892) pp. 146–8.

|| Bull. Soc. Mycol. France, vii. (1891) pp. 76–80. See Bot. Centralbl., 1891, Beih., p. 168.

¶ Bull. Soc. Mycol. France, vii. (1891) pp. 101–3. See Bot. Centralbl., 1892, Beih., p. 168. Cf. this Journal, 1891, p. 384.

nor cystids, but very peculiar conids. They are mostly ovoid in form, $8-12 \times 6-8 \mu$ in size, thick-walled, and of an intense reddish-yellow colour, and are borne in chains of from 3 to 10.

Protophyta.

a. Schizophyceæ.

Cell-contents of the Schizophyta.*—Herr H. Zukal states that if filaments of *Tolyptothrix* (e. g. *T. lanata*) are examined in the autumn, the cells in the lower part of the filament are seen each to contain a large "nucleus," which itself encloses a definite "nucleole." The upper part of the same filament frequently consists of a hormogone with oscillaria-like habit, the cells of which contain no trace of a "nucleus." By cultivation Herr Zukal established the fact that the so-called "nucleus" in the large cells rapidly divides into two, four, eight, &c., "nuclei," these constituting the so-called "granules," which have frequently been described as occurring in the cells, and that the so-called "nucleoles" are not true nucleoles, but nuclei, around which the protoplasm has collected in the same way as it does round the nuclei in the asci of the Ascomycetes. The granules exhibit all the properties of nuclei in the position in which they place themselves in the cell, &c., though their micro-chemical reactions are difficult to determine, owing to the presence of the phycocyanin. He obtained evidence, however, that the cells of the Cyanophyceæ contain a chromatophore coloured by phycocyanin, and a colourless cytoplasm, in which the nucleus, or more commonly the nuclei or granules, are imbedded.

The cells of the Schizomycetes or bacteria contain bodies of precisely the same character as the nuclei or granules of the Cyanophyceæ.

Nucleus in the Cyanophyceæ.†—M. P. A. Dangeard believes that he has detected a true nucleus in *Merismopedia convoluta*. Fixing with absolute alcohol and then staining with hæmatoxylin showed the presence of a central corpuscle occupying one-third or one-half of the cell, and strongly stained. It was usually spherical, but sometimes of irregular form or stellate, and in that case the substance was somewhat granular, in the former case homogeneous. No trace of a nucleole could be detected.

Propagation of Diatoms by Germs.‡—Sig. L. Macchiati records an observation of a specimen of *Navicula elliptica*, within the siliceous coating of which were inclosed four other individuals which he regards as germs; they agree with the parent plant in every respect except their much smaller size: the transverse and longitudinal diameters were scarcely one-third of those of the inclosing specimen.

Biology of Diatoms.§—Dr. P. Miquel finds that a temperature of -15° C. entirely destroys the vitality of diatoms, as well as of green

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 51-5, and SB. K. K. Akad. Wiss. Wien, ci. (1892) pp. 301-27 (1 pl.).

† Le Botaniste (Dangeard), iii. (1892) pp. 28-31 (1 pl.).

‡ Bull. Soc. Bot. Ital., 1892, pp. 168-72.

§ Ann. de Micrographie, iv. (1892) pp. 321-49.

Algæ and Infusoria. Freshwater diatoms can, however, thrive in water at the freezing point, but the freezing of the medium exercises a fatal effect upon them. Desiccation is fatal to diatoms, and they are not able, as has been asserted by some writers, to return to life after having been completely dried up. The most favourable rays of light for the cultivation of diatoms are the yellow; next the blue and green; the white and red rays are inactive. Freshwater diatoms should, therefore, be cultivated behind yellow glass. A temperature above 45° C. is rapidly fatal to their development.

Classification of Diatoms.*—Dr. J. Pelletan proposes the classification of Diatoms into 2 sub-orders, Placochromæ and Coccochromæ, 9 families, and 24 tribes. The Placochromæ consist of the families Cymbellaceæ (Achnantheæ, Gomphonemæ, and Cymbelleæ), Nitzschiaceæ (Nitzschiæ), and Naviculaceæ (Amphiproræ, Pleurosigmæ, Naviculæ, Surirellæ, Synedreæ, and Eunotieæ); the Coccochromæ of the Tabellariaceæ (Tabellariæ, Licmophoreæ, and Rhizosoleniæ), Fragilariaceæ (Fragilariæ, Plagiogrammæ, and Trachyspheniæ), Chætoceraceæ (Chætoceræ), Biddulphiaceæ (Biddulphiæ), Coscinodisceæ (Eupodisceæ, Heliopelteæ, Asterolampreæ, and Coscinodisceæ), and Melosiraceæ (Xanthopyxideæ and Melosiræ). The further classification into tribes and genera follows.

Cymbellaceæ.†—Dr. J. Pelletan classifies the genera belonging to this family of diatoms into three tribes, viz.:—(1) Cymbelleæ, a single plate of endochrome resting by its middle on one of the sides of the zone, and by its margins on the other side; frustules unsymmetrical, with a convex dorsal and a straight or concave ventral side:—*Cocconema*, *Amphora*, *Cymbella*, *Epithemia*, *Encychnema*; (2) Gomphonemæ, a single plate of endochrome, of which the middle rests on one side of the zone, its margins on the other side; frustules cuneiform:—*Rhœicosphenia*, *Gomphonema*; (3) Achnantheæ, a single plate of endochrome lying on the internal face of the upper or dorsal valve; frustules curved or geniculate, generally epiphytic; valves unlike; raphe and nodules on the lower or ventral valve; a pseudoraphe, but usually no nodules, on the upper valve:—*Cocconeis*, *Cyclophora*, *Cymbosira*, *Achnanthes*, *Achnanthidium*, *Gephyria*, *Eupleuria*, *Rhœiconeis*.

M. P. Petit appends a different classification of the Achnantheæ, comprising the same genera, with the exception of *Achnanthidium*.

β. Schizomycetes.

Classification of Schizomycetes.‡—In discussing the present chaotic condition of the classification of Schizomycetes, Prof. H. M. Ward suggests that two main causes have tended to bring about this undesirable end, the first being that the botanists have confined themselves too closely to the morphological characteristics, while the bacteriologists have laid too much stress on the behaviour of the species towards the media. The various systems of classification in vogue are then passed

* Journ. de Micrographie, xvi. (1892) pp. 57–8, 89–90. † Tom. cit., pp. 89–90.

‡ Ann. of Bot., vi. (1892) pp. 103–41.

in review, the one receiving favourable notice being that of Zopf, although Miquel's system finds commendation, and that of De Toni and Trevisan is distinguished as being the most recent and most thorough. This last, published in 1889, describes over 650 species; and when it is remembered that Winter's list published in 1881 contained only 69 species, the thought naturally occurs that something ought to be done to keep down or diminish this ever-multiplying horde.

According to the author one of the most prolific sources of this generation of multiple species has been their growth under different conditions, and "if we could have every 'species' that will grow on a normal gelatin at 20° C. compared on that medium and at that temperature under like conditions, the advantage would be enormous, and similarly with all 'species' which will only flourish in bouillon at 35° C., and so on."

It is suggested that those concerned with Schizomycetes (especially persons with a floral or ideal bias, and those with a hygienic or practical turn) should come to some arrangement, so that in describing a new species certain definite data marks and characters should invariably be given:—For example, (1) habitat; (2) nutrient medium; (3) gaseous environment; (4) temperature; (5) morphology and life-history; (6) special behaviour; (7) whether pathogenic, saprophytic, nitrifying, &c.

Of course the foregoing seven points are thrown out as suggestions to form a sort of rule-of-thumb method of examination which should be applied to every organism, and these points are not meant to exclude any other marks or characters suitable for identifying or locating an organism and describing a species.

Nitrification.*—The explanation of the difference between the nitrifying process as observed under artificial and under natural conditions has been sought in a weakening of the ferment of the artificial cultivations, and in the co-operation of two different kinds of nitrifying organisms when acting under natural conditions, i. e. in the soil.

From experiments made with soil taken from all quarters of the world Herr Winogradsky concludes that two organisms are employed in natural nitrification, one forming nitrite and the other nitrate, and hence the process is completed in two periods. The two micro-organisms were isolated on solid media, the nitrate-former being oval, about 0.5 μ long, and 1½–2 times less in breadth. The nitrite-forming organisms are oval or spheroidal, and about double the size of the nitrate-formers.

Further investigations showed that in normal earth, nitrate only is formed, the production of nitrous acid being a transitory phenomenon, and, even in the presence of considerable quantities of ammonia, being oxidized as soon as formed. The nitrite ferment, either under natural or under artificial conditions, can only form nitrite, and nitrous acid thus formed remains as such in the ground if the nitrate-former be absent.

If, however, nitrate as well as nitrite forming ferment be added to sterilized earth, the process is completed in the natural way, only the merest traces of nitrous acid appearing.

* Annales de l'Institut Pasteur, 1891, p. 577. See Centralbl. f. Bakteriologie u. Parasitenk., xi. (1892) pp. 195–8. Cf. this Journal, 1891, p. 680.

Bacillus Pseudanthracis.*—Herr W. Wahrlich describes a new bacillus which, from its resemblance to that of anthrax, he calls *pseud-anthraxis*. Its development was studied in meat-pepton-agar, meat-pepton-gelatin, and potato.

The spores, 0.6μ broad and $1.3-1.8 \mu$ long, germinate in about 3 hours, forming filaments $1-1.15 \mu$ broad. The growth increased till the seventh day, when the contents of the filaments began to be granular, and by the fourteenth most of them were dead, and empty cases and no spores were formed. Spore-formation was obtained by cultivating in test-tubes on meat-pepton-agar. On plate cultivations with meat-pepton-gelatin the colonies were 3-4 mm. broad by the fourth day and the gelatin was liquefied.

Some of the diagnostic criteria between the true and pseudanthrax are enumerated, e. g. the ends of the cells are rounder and the spores cylindrical rather than oval; the scum forming on liquefied gelatin does not sink of itself, but only after shaking, and the scum forms anew on the surface of the culture.

Only one animal, a mouse, was submitted to inoculation. This died five days after injection, and did not present the post-mortem appearances characteristic of anthrax.

Two new Microbes of Stringy Milk.†—The researches of the past few years have, says Prof. A. Guillebeau, determined that the viscosity of milk may be produced by at least fourteen different micro-organisms; to these the author now adds two more, *M. Freudenreichii* and *Bact. Hessii*.

The milk of a particular dairyman at Berne from time to time became stringy, this condition being accompanied by a disagreeable odour. In this milk was found a large motionless coccus. It is alike aerobic and anaerobic, sometimes forms chains, and grows easily in the usual nutritive media. Bouillon becomes slightly stringy, and gelatin, first liquefied, markedly so. On potato the cultivations were of a pale yellow to a yellowish-brown colour, and on this medium the diameter of the cocci was as much as 2μ .

Sterilized milk becomes so viscous that threads of 5 dm. to 1 m. long can be drawn out. In non-sterilized milk kept at 20° , the viscosity is perceptible 5 hours after inoculation, soon afterwards the liquid turns bitter, and in a few days the casein is precipitated as a fine granular deposit. The coccus seems to grow as well on acid as on neutralized media, but is not so large. The optimum temperature is 20° but the coccus will grow at from $12^\circ-35^\circ$. It retains its vitality and energy for many months. From an experiment made by injecting the udder of a goat with 5 gm. of a bouillon cultivation, it appeared that the coccus could not only exist in the animal organism but set up the viscous condition.

B. Hessii was accidentally discovered on a cow feeding on the Alps at 1200 m. high; cultivated on potato it measures 3-5 μ long by 1.2μ broad. The ends are rounded and stain more deeply than the middle. It is extremely mobile. Gelatin is liquefied and bouillon

* S.A. aus Scripta Botanica, 1890-1, 30 pp. (3 pls.). See Centralbl. f. Bakteriöl. u. Parasitenk., xi. (1892) pp. 52-3. † Annales de Microgr., iv. (1892) pp. 225-37.

rapidly changed into a viscid mass, but the stringiness was not so marked a feature as with the *M. Freudenreichii*. It is a distinctly aerobic organism, only just growing in an airless environment, but it can accommodate itself to various degrees of temperature. This organism appears to be endowed with the power of converting cream of sterilized milk into butter, a change effected by the ferment action, while pasteurized milk, i. e. milk heated to 69° for 20 minutes, becomes stringy in 14 hours. *B. Hessii* appears to be a pure saprophyte and has no pathogenic action.

Both these new organisms are easily destroyed by heat and other disinfecting methods.

Bacteriology of Influenza.*—Sig. A. Bruschetini took 5–10 ccm. of blood from a brachial vein during the height of the febrile stage. The blood was received into sterilized test-tubes and incubated at 37°. In this way copious cultivations which were easily grown when transferred to other media were obtained. On gelatin and bouillon a moderate development took place in presence of air at 37°, while if the air were excluded the growth became luxuriant. In bouillon a clouding due to formation of minute flakes at first occurred, but as these deposited on the bottom the fluid became clear. The growth on glycerin-agar resembled that described by Kitasato, but afterwards the colonies ran together, forming a thin, moist, shining, greyish overlay. Similar results were obtained by Dr. K. Markel, who found that the influenza bacillus developed in fluid agar; by the fourth day a delicate cloud appeared on the surface and grew gradually downwards.

This author injected rabbits with influenza blood, and the animals became feverish and died on the fifth day. In their blood were found crowds of ovoid bacilli, and these were afterwards cultivated on artificial media. If a healthy rabbit be injected with the blood of an animal dead of the disease it will live, thus showing a weakening of the bacillus by passing through a rabbit.

Dr. A. Pfuhr † has isolated from several cases of pure uncomplicated influenza a small micro-organism which tends to group itself in pairs, though chains of several or numerous individuals could be observed under a 1/12 immersion. These bacilli were obtained from perfectly fresh sputum which had been roughly filtered to get rid of the coarser particles, no attempt being made to separate the buccal from the respiratory secretion. Cover-glass preparations were easily stained with Neelsen's solution, but Gram's method failed. Little success was obtained from examining the blood; only in one instance did the author discover a few bacilli between the red discs, and he thinks that examination of the blood is less trustworthy than that of fresh sputum.

A micro-organism resembling that obtained from sputum was cultivated on 5 per cent. glycerin-agar, whereon it formed small dewy looking colonies. Bouillon became cloudy in 24 to 48 hours, but there was ill success with gelatin and potato. By means of Canon's method several micro-organisms developed after incubation at 37°. Some of these, e. g. *Staphylococcus aureus* and a *Sarcina*, were obvious impurities,

* La Riforma Med., 1892, No. 23. Casop. Lék. Cesk., 1892, c. 6. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 412–3.

† Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 397–406.

but colonies of two different kinds of bacilli appeared, and one of these was identified as the bacillus obtained from sputum.

The author considers this bacillus to be the exciting cause of influenza. It is a thin rodlet about half as long again as broad, with rounded ends, the individual elements being frequently bent and often in pairs, but less rarely in chains. Injection experiments made on animals (rabbits) were unsuccessful.

Sig. C. Bergonzini* has isolated the same bacterium in five cases of influenza, four times from the blood and once from the urine. The bacteria are micrococci about 0.001 mm. in diameter; they form an ash-coloured scum on agar, and are seen lying in pairs or irregular groups. On blood-serum they form a white superficial deposit along the inoculation track when cultivated at 36° for 24 hours. On gelatin at 20° a white liquefying colony appears after three days. Growth at 15° to 18° is very tardy, and the liquefaction of the gelatin is suspended. They no longer develop at 6° to 8°.

Inoculations of the micro-organism, which the author calls *M. cinereus*, on rabbits and white mice were without result, so that the author doubts the pathogenic character of the microbe.

Conjugation of Chromatium Okeni.†—Herr F. Förster describes a notable phenomenon in the life-history of the purple sulphur bacterium *Chromatium Okeni*. In making a microscopical observation he noticed a pair possessed of flagella, revolving around an axis common to the pair. When they came to rest the pair lay parallel and their flagella were quite free. The bodies of the two organisms were united by a hyaline filament or connecting bridge. By means of a high power the bridge was found to be a cordlike extension from the central colourless portion of one individual in connection with a similar extension from the other. At the point of junction there was a slight expansion or thickening. After an hour or two the pair separate and their half-bridges disappear. To the foregoing or general aspect of the question several details may be added. The half-bridge may appear at other positions than about the centre of the side; its appearance varies with the focusing, no junction being visible from the surface, while a transverse line is seen at about the middle. There may be no expansion, and more than two individuals may be found in connection. It seems fairly certain that the bridges are extensions from the central portion of the organism, since these when stained are quite homogeneous.

The author's statements are clearly depicted in numerous coloured illustrations.

Phosphorescent Bacterium.‡—Prof. R. Dubois has been able to isolate and cultivate a phosphorescent bacterium which he calls *Photobacterium sarcophilum*. It occurred on the corpse of a rabbit, and exhibited four varieties, of which only one was phosphorescent. Dubois believes that this bacterium is luminous only when living in media containing some salt, some nitrogenous substance like neurine, some food such as glycerin, and phosphorated substances. The phosphorescence is wholly due to the physiological activity of the bacterium itself.

* Soc. Med. Chir. di Modena, Feb. 7, 1890. See Centrabl. f. Bakteriolog. u. Parasitenk., xi. (1892) pp. 442-3.

† Centrabl. f. Bakteriolog. u. Parasitenk., xi. (1892) pp. 257-64 (1 pl.).

‡ Bull. Soc. Vaud. Sci. Nat., xxvii. (1892) pp. 251-8.

Bacillus Cubonianus.*—Under this name, as a new species, Sig. L. Macchiati describes the bacillus which causes "bacterosis" on the leaves of the mulberry. It is a somewhat polymorphic species, but is quite distinct from the *Streptococcus* which attacks the silkworm. It is endowed with an extraordinary mobility, displaying movements of oscillation, translation, and curvature. It is enclosed in an obvious mucilaginous sheath, and the cell-contents consist of protoplasm and a large number of minute starch-grains. There is distinct continuity of protoplasm from cell to cell. The cells have the form of short rods, $1.25-2.0 \mu$ in length, and $0.75-1.0 \mu$ in breadth. They are ordinarily propagated by division while still enclosed in the mucilaginous sheath; but also by spores, which are formed even under favourable conditions of nutrition, at an optimum temperature of $32^{\circ}-35^{\circ} \text{C}$.

Bacterosis of the Grape-vine.†—Sigg. G. Cugini and L. Macchiati describe a new disease of the vine, which attacks the grapes in northern Italy, causing them first to turn brown, then to become dry and brittle. It is caused by a bacillus, about $3-4 \mu$ long and 0.25μ broad, usually solitary, sometimes united together in twos or threes, rarely into filaments.

Spoilt Maize and its Micro-organisms.‡—Sig. A. Monti and Sig. V. Tirelli find that even by direct microscopical examination of ground-up maize-grains, fungi and spores could often be detected, and occasionally also bacteria and cocci. From cultivations a large number of fungi, yeasts, and bacteria were obtained. Among these were pretty constant *Penicillium glaucum*, *Mucor racemosus*, *Rhizopus nigricans*, *Saccharomyces sphær. alb.*, *B. mesent. vulg.*, *B. subtilis*, *M. aurantians*, a liquefying micrococcus, a short rodlet resembling Friedlaender's bacillus, *B. citreus*, and some fluorescing bacilli. The number of the colonies was diminished, though always remaining considerable, if the surface of the maize-grains was well disinfected. Control plates, inoculated with healthy grains, the surface of which had been disinfected, nearly always remained sterile.

Bacteriology of Cystitis.§—Dr. A. Morelle, who has made quite an exhaustive examination of the micro-organisms found in urine associated with inflammation of the bladder, sums up his experiments as follows:—

In cystitis several kinds of organisms are engaged, and, apart from the tubercle bacillus, the most important of these are *Staphylococcus* and *Streptococcus pyogenes*, and *Bacterium pyogenes* (Albarran and Halle). The cocci set up a purely suppurative cystitis and the urine is usually alkaline owing to the decomposition of urea.

Bacillus pyogenes has no action on urea, being found only in acid urine, and is probably the most important of the micro-organisms infesting the urinary tract. *Bacillus pyogenes* is none other than *B. lactis aerogenes* (Escherich) met with in the motions of suckling infants, and this again is only separated by slight differences from *B. coli communis*. *B. pyogenes* vel *B. lactis aerogenes* has been described under other names by Clado, Rovsing, and Doyen (bactérie septique de la vessie, *Cocco-*

* Malpighia, v. (1892) pp. 289-303 (1 pl.).

† Le Stazioni sperim. Ital., xx. (1891). See Bot. Centralbl., l. (1892) p. 24.

‡ Rivista d'Igiene e San. Pub., ii. (1891) No. 1. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) p. 470.

§ La Cellule, vii. (1891) pp. 211-86 (1 pl.).

bacillus ureæ pyogenes, &c. &c.) When injected into the urinary tract of dogs it sets up general disturbances and alterations in the urine (presence of pus-cells). These symptoms are, however, transitory, and after a few days all morbid phenomena have disappeared; the bacteria, however, continue to exist in the urinary tract. *B. lactis aerogenes* is widely disseminated, is met with in urine allowed to stand, as well as in that passed incontinently, and is probably the cause of the gaseous condition observed in diabetic urine.

Anaerobiosis of *Bacillus coli communis*.*—M. M. Ide finds from experiments made with *B. coli communis* that this micro-organism develops with difficulty in the absence of air in a medium consisting of meat-extract and pepton.

Directly, however, oxygen is supplied multiplication becomes abundant. Hence oxygen is an important consideration for the development of *B. coli communis*, but it may be replaced, and that with advantage, by glucose. A combination of oxygen and glucose naturally results in the maximum development.

Production of Fat Pigment (Lipochrome) by Bacteria.†—The observations of Dr. A. Overbeck on the production of lipochrome were made with *Micrococcus rhodochrous*, a fission fungus isolated from the stomach of a goose, and with *Micrococcus erythromyxa* isolated from water. The author's observations are in a sense the extension of those researches made by Zopf on *Bacterium egregium*, the lipochrome of which is a yellow pigment called by Zopf bacterioxanthin, to distinguish it from the mycoxanthin and the anthoxanthin of the higher fungi.

M. rhodochrous was found to grow best on a medium composed of 10 per cent. gelatin, 2-3 per cent. meat extract, 2 per cent. sugar, and 0.2 per cent. NaCl, but it was from the cultivations on potato that the pigment was most conveniently obtained. The pigment, the hue of which varied somewhat according to the cultivation medium, was soluble in carbon sulphide, petroleum ether, chloroform benzol, ethyl and methyl alcohol. By careful evaporation of the solution, a reddish-yellow greasy substance with a fatty smell was obtained.

That this substance was lipochrome was shown by saponifying with caustic soda, separating the soap with salt, and extracting the pigment with petroleum ether. Examined spectroscopically, the purified pigment gave an absorption band lying about F. The author after discussing the micro- and macro-chemical reactions of the pigment, alludes to the experiments showing that the pigment formation is independent of light, and that it is unaffected by the quality of the light. This micro-organism does not liquefy gelatin, nor peptonise albumen. It seems to grow best at ordinary temperatures.

With regard to *Micrococcus erythromyxa*, it may be said that while this micro-organism has much in common with *M. rhodochrous*, it has several distinguishing features, the most prominent being that it can produce two kinds of pigment, one a lipochrome, and the other a yellow amorphous pigment, soluble in water, while another is that of exciting the lactic acid fermentation.

* La Cellule, vii. (1891) pp. 325-44.

† Verhandl. K. Leopold.-Carol. Deutsch. Akad. d. Naturf., lv. (1891) pp. 399-417 (1 pl.).



MICROSCOPY.

a. Instruments, Accessories, &c.*

The Microscope. Guide to Microscopical Technique.† — This small text-book of 140 pages contains a concise though fairly complete account of (1) the Microscope and its accessories; (2) the use of the Microscope; (3) preparations; (4) graphical representation of preparations. In the first section is a short history of the Microscope, followed by a description of its optical arrangements, from those of the very simplest to those of the most perfect instruments replete with the latest improvements. The second section treats of the use of the instrument, and contains a full account of the methods of adjustment and illumination, the different sources of light, &c. The third section deals with the production of preparations of various materials. It also contains directions for the treatment of living objects, and for the cutting of sections, &c. The last chapter is devoted to the graphical representation of preparations. The various kinds of drawing apparatus are first described, and then the methods and appliances for photomicrography and projection are fully discussed. The whole book is plentifully illustrated with plates and figures.

(1.) Stands.

Zentmayer's American Continental Stand.—This stand has been designed to meet the wants of those workers who while preferring the compact Continental model are conscious of its inherent defects. It is substantially a combination of the upper half of American with the lower half of the best Continental stands.

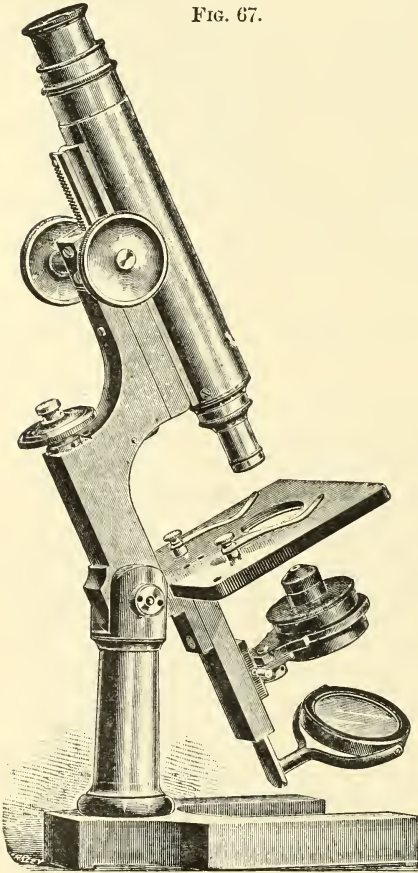
The stand is constructed entirely of brass; the base is of horse-shoe form, filled with lead for extra weight, and gives perfect steadiness in every position. A stout pillar firmly supports the arm of the instrument on a trunnion-joint, which allows all inclinations from the perpendicular to the horizontal position. The coarse- and fine-adjustments are of the same style and construction as in the Centennial stand. The arm carrying the body is provided with two slides, the upper and longer one bearing the tube with rack-and-pinion movement, and sliding in the lower one, which is controlled by a lever of the second order, operated by a milled-headed micrometer screw in convenient position at the back of the instrument. At the bottom of the lower slide there is a shoulder against which the lever acts, and a spring above presses down against this shoulder, insuring its continuous contact with the lever during adjustments. All the mechanism is concealed within the arm, which is so hollowed as to secure both lightness and greater rigidity. This fine-adjustment is absolutely free from lateral motion, and exceedingly sensitive. Its construction prevents wear, and a revolving nose-piece and attached objectives can be easily carried without injury. It also acts as a safety appliance in case an objective is accidentally racked down against an object, for the spring yields quickly to upward pressure. The body-tube is $5\frac{1}{2}$ in. long, with draw-tube extending full 10 in., thus

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† Schweiger-Lerchenfeld, A. v., 'Das Mikroskop. Leitfaden der mikroskopischen Technik nach dem heutigen Stande der theoretischen und practischen Erfahrungen.' Wien, Pest, and Leipzig, 1892, 8vo, 192 figs. See Bot. Centralbl., 1. (1892) pp. 261-2.

giving both English and Continental standards, and accommodating objectives corrected for either length. The spacious stage is made of aluminium, which is incorrodible; the dimensions ($3\frac{1}{2}$ in. square) are commodious even for culture slides or serial sections; the surface is plane, with recessed opening to receive a glass plate, light-modifier, or disc-

Fig. 67.



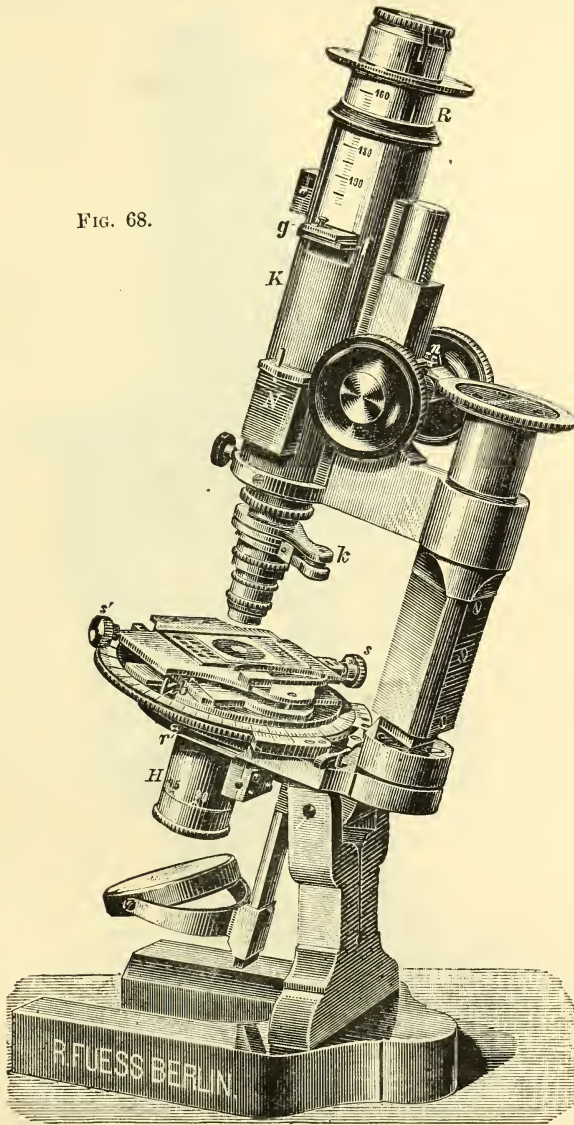
diaphragm, if wanted; removable clips are provided, with springs shaped and adjusted to hold a slide, and yet allow easy movement about the field of view. The substage has long sliding movements in the fixed bar beneath the stage, allowing ample room for a condenser or polarizer, and exact adjustments are easily and quickly made by aid of milled knobs extending on each side of the sliding bracket, on which the ring of the substage is centered and affixed instantly by means of a single set-screw with capstan head. The mirrors are plane and concave, of large size, and have complete adjustments on an extensible bar. The diaphragms are cone-shaped, and have three different sizes of apertures. The Abbe illuminating apparatus has a condenser of 1.20 N.A. and iris diaphragm with complete movements. A condenser of 1.40 N.A. can be substituted, if preferred. A set of stops are also furnished for dark-ground illumination.

A modification of the swinging substage and mirrors has been effected, whereby the extensible mirror-bar slides in another bar which swings from a joint on the under side of the swinging-

bar carrying the substage. This construction allows the substage and mirrors to swing independently of each other, click-stops indicating when either or both bars are in the optic axis of the instrument; and permits the substage to be swung aside entirely and the mirrors alone to be then swung into positions for central or oblique illumination, without interference from the substage. The mirrors can be likewise swung aside completely to permit the use of direct illumination, with or without substage apparatus. These movements contribute much to convenient and rapid use, as it is unnecessary to remove and afterward return the substage, or mirrors, or any other part. In this instance the stage is made somewhat narrower to allow the substage to swing clear aside.

Fuess Microscopes.*—The Fuess model No. II. (fig. 68) is similar to the larger instrument described in this Journal, 1891, p. 393. The stand can be inclined to the horizontal. The rotating stage is divided

FIG. 68.

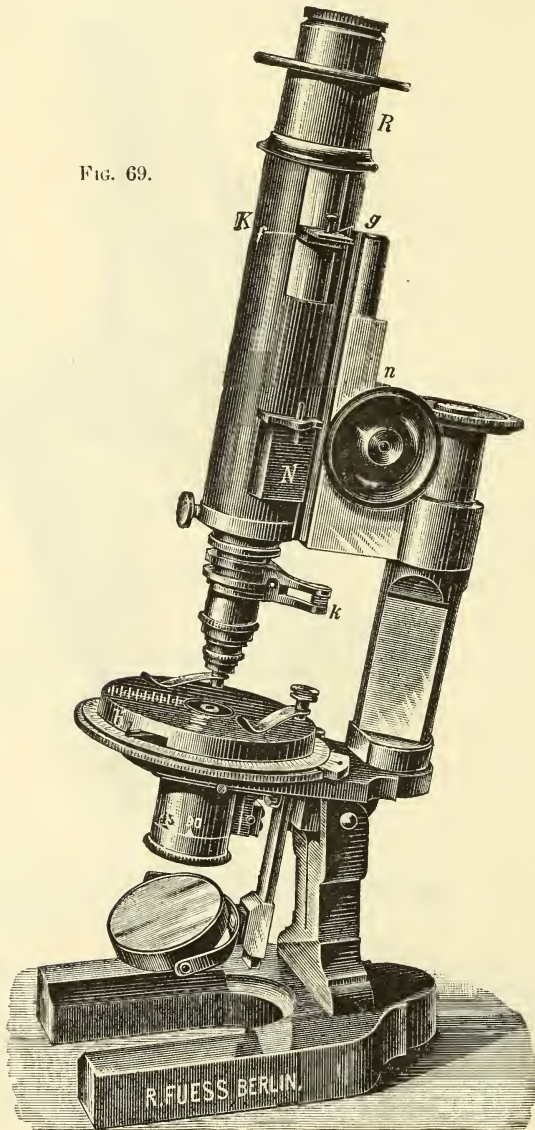


into 360°, with two verniers reading to 5 minutes. It can be fixed in any position by means of a lever. The polarizer has a rack-and-

* Fuess, R., 'Krystallographische u. Physikalische Instrumente,' Berlin, 1891, 56 pp., 55 figs.

pinion motion. In its socket fit the various illuminating apparatus, which can be centered by slide pieces provided with screws. Arrangements for obtaining convergent and parallel light can be inserted.

FIG. 69.



The mechanical stage (fig. 72, p. 669) is similar to that of the larger model, but has no micrometer measuring arrangement.

All the special eye-pieces and other accessories of the model No. I. can be used with this instrument.

Model No. III. (fig. 69) does not differ very much from the preceding. The stage is provided with cross-divisions for the orientation of the preparation ; but if required the mechanical stage of model No. II.

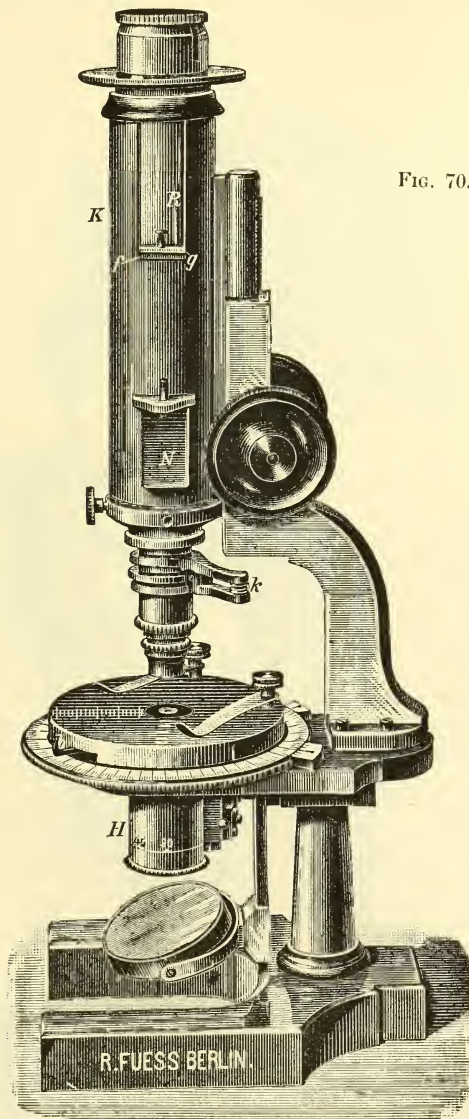


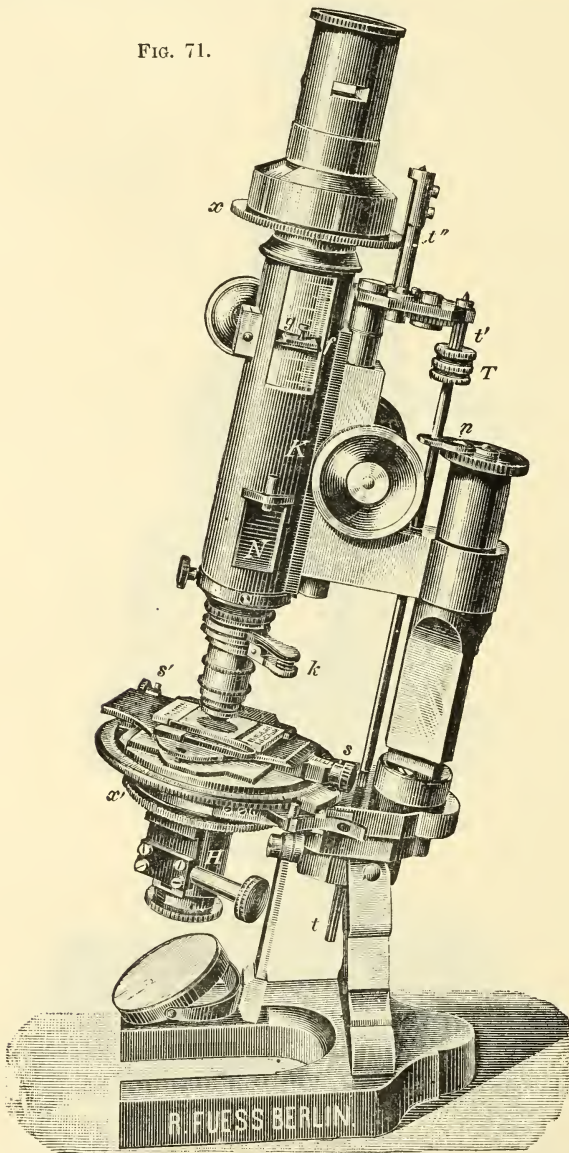
FIG. 70.

can also be applied to this instrument. The draw-tube is only movable by hand, and carries no millimetre divisions.

In model No. IV. (fig. 70) the stage is fixed. The only focal adjustment is by rack and pinion, which, however, is sufficiently fine for the

use of objective No. 7. The instrument is provided, like the others, with means for fixing the stage, polarizer and analysers, arrangements for convergent and parallel light, Bertrand lens, objective clamp, &c.

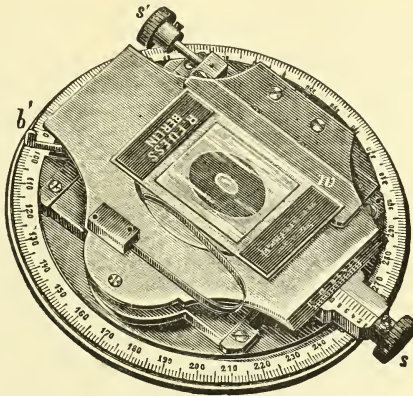
FIG. 71.



Model No. VI. (fig. 71) is in size and construction precisely similar to model No. II., but differs from it and the other instruments by a

special arrangement for the simultaneous rotation of the two nicols. This construction is obviously borrowed from the Dick Microscope as made by Mr. Swift, and described in this Journal, 1889, p. 432. The

FIG. 72.



Microscope is particularly suitable for the observation of glowing minerals in polarized light.

Combination of Microscope and Reflecting Goniometer.*—Prof. A. Schrauf describes a combination of Microscope and goniometer which is useful for the measurement of minute crystals; the ordinary telescope of the goniometer fails to give sufficient magnifying and defining power to enable the edges of very small crystals to be properly centered and adjusted. For the measurement of such crystals he proposes to add to the ordinary instrument a Microscope directed vertically with its line of sight passing through the axis of the goniometer. Since the collimator and telescope are inclined at 35° to the horizontal, the Microscope can be easily supported by a side tube vertically above the crystal. The ordinary telescope serves for approximately centering and adjusting the crystal, while the more exact adjustment is made with the Microscope. According to the intensity of light from the faces of the crystal, the following methods of observation may be applied.

(1) The complete Microscope is used. In the goniometrical measurements the faces belonging to one zone will then appear successively in the field of view. By arresting them at the maximum of their intensity "Schimmer" measurements are obtained.

(2) By separating the whole Campani eye-piece, an image of the signal, as formed by the objective, is seen and can be used for approximate measurements.

(3) If the upper lens only of the Campani eye-piece be removed, a double appearance is seen on the reflecting face of the crystal. The face no longer shines with a uniform light, but gives a series of clear signals close to one another. The "Signal-Schimmer" measurements obtained by this means are more correct than those of (1).

* Zeitschr. f. Wiss. Mikr., ix. (1892) pp. 128-30.

(4) By inserting between eye and body-tube a Ramsden eye-piece, a single clear image of the signal, which can be adjusted on the cross wires, is obtained.

(5) The above methods are equally applicable to the simple goniometer without telescope and collimator.

(2) Eye-pieces and Objectives.

Fluorite in Achromatic Objectives.* — Mr. E. M. Nelson remarks — “As fluorite is becoming scarce, an important question arises as to whether fluorite is or is not present in any given lens. This can readily be determined by means of a polariscope.

The Nicols are crossed, a 2-in. objective is placed on the nose-piece, and a low eye-piece employed. The various portions of the objective to be tested are unscrewed, and each combination is separately placed on a glass slip on the stage and examined in the dark polarized field. If the combination contains fluorite there will be a luminous white silky appearance, but if there is no fluorite, then the field will remain dark.

The following are examples:—The Zeiss 24-mm. apochromatic has three elements, of which the middle contains fluorite. The apochromatic 12 mm. has four elements, of which the second and back contain fluorite. The apochromatic 6 mm. has three elements, of which the middle and back contain fluorite. The apochromatic 3 mm. has five elements, and the last but one contains fluorite.

But with regard to this last example, it should be noted that all 3- and 2-mm. objectives are not alike.”

(3) Illuminating and other Apparatus.

A New Spherometer.—Mr. E. M. Nelson communicates the following:—Nearly all spherometers are graduated in dioptries, as they are chiefly employed for measuring the foci of spectacles. This graduation is inconvenient if you require the radius only. The size of the spherometer ought to bear some proportion to the size of the lens to be measured, consequently for general purposes more than one spherometer would be required. A large lens, for instance, with shallow curves, can be more accurately measured by a large spherometer, which would not measure a small lens at all; moreover, as spherometers are expensive instruments, and as at least three of them would be required, it seemed better to design one that would be suitable, and, at the same time, be as simple in construction and as accurate as any hitherto made.

The usual form of spherometer is that shown on p. 131, fig. 19, of this Journal for last February, in the admirable paper by Prof. Silvanus Thompson on his new focometer.

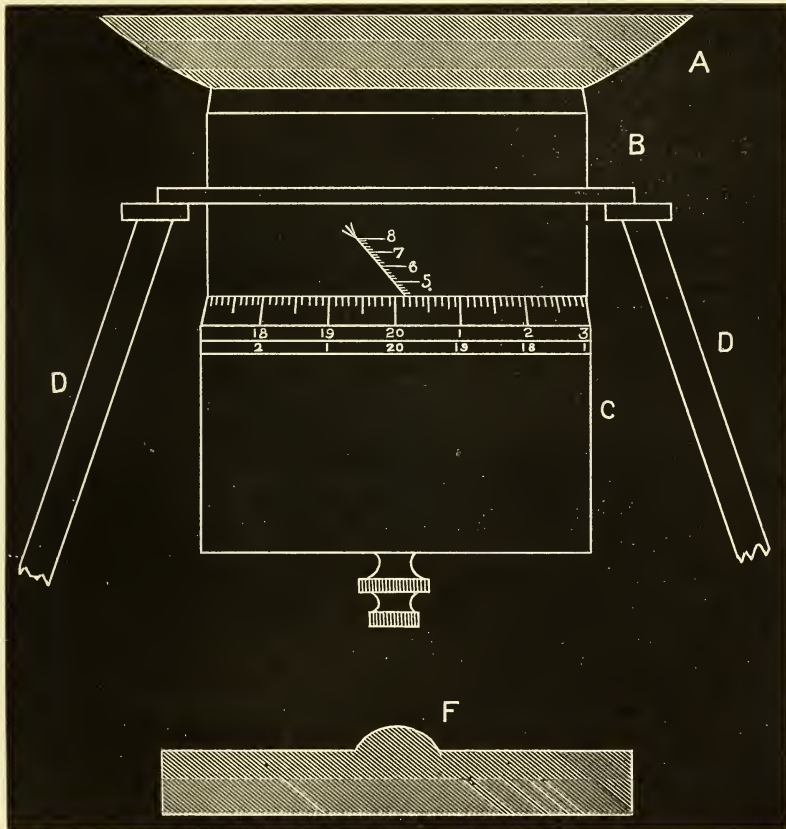
The principle on which these instruments depend is the measurement of the versed sine with a given chord.

Now the defect in the principle employed in the spherometer shown in fig. 20 is that you cannot be sure that the chord between the two fixed points is that of a great circle of the sphere; if it is not, the result will be inaccurate.

* Journ. Quek. Micr. Club, v. (1892) p. 122.

By the three fixed points in fig. 19 that error is eliminated. But to make three points which shall include accurately a given chord is a matter of some difficulty ; I therefore determined to simplify mine by

FIG. 73.



A, lens being measured ; B, ring ; C, drum-head ; D D, legs of tripod, 9 in. long ; E, glass plane surface ; F, lens for examination of Newton's rings.

dispensing with the three points altogether, and by substituting for them a ring. The ring is of course much cheaper to make, and that, too, with less liability to error.

The screw is common to both, and the error on that score is the same in either case ; but with regard to accurate centering the ring probably has rather an advantage.

There is a difference in the way of using them, for while the spherometer in fig. 19 rests on the lens, in this one the lens rests on the spherometer.

My spherometer consists of a cylindrical ring supported on a tripod ;

in the centre of this cylinder is a micrometric screw of 50 threads to the inch, having its lower end fixed to the drum-head. The edge of the drum-head is divided in the usual way, each division representing $1/10,000$ th inch. The upper row of figures are for measuring convex lenses, while the lower are for concaves.

The upper end of the screw which touches the lens terminates in a small polished hemisphere of steel, contact being indicated by the formation of Newton's rings which can be seen through the lens which is being measured.

Only the lower edge of the ring is in contact with the inside of the drum-head, and contact at this point steadies the screw.

The figure shows the instrument in use with a full-sized ring; but when a small lens is to be measured the full-sized ring is replaced by a smaller one, the same screw and drum-head being used in all cases.

This instrument has three rings, and is practically three spherometers.

Before using the instrument a glass disc $1/2$ in. thick, worked on its under side to a true plane surface, and having a plano-convex lens cemented to its upper side, is placed on the ring; the drum-head is then turned until the hemispherical end of the screw comes in contact with the lower side of the glass disc; the Newton's rings formed by this contact will be plainly seen through the lens on the upper side of the glass disc. When this contact is made the index on the drum-head should be at zero; if it is not it can be placed there by means of the adjusting screws below the drum-head.

With regard to the diameters of the rings, if a chord of suitable dimensions is chosen the arithmetical computation of the radius can be much shortened. Thus—

Let R be the radius, C the chord, and V the versed sine which is measured, then

$$R = \frac{V^2 + \left(\frac{C}{2}\right)^2}{2V}.$$

If, therefore, we make $C = \sqrt{8} = 2.82843$ inch,

$$R = \frac{V}{2} + \frac{1}{V}.$$

Or $C = \sqrt{2} = 1.41421$ inch,

$$R = \frac{1}{4} \left(2V + \frac{1}{V} \right).$$

And if $C = \sqrt{.2} = .447214$ inch,

$$R = \frac{1}{40} \left(20V + \frac{1}{V} \right).$$

As $\frac{1}{V}$ can be taken out of a table of reciprocals, the computation becomes one of mere inspection.

The above are the diameters of the three rings of this instrument.

(4) Photomicrography.

Photomicrographical Apparatus.*—Prof. Martens has fitted up in the Königliche Mechanisch-Technische Versuchsanstalt in Berlin a photomicrographical laboratory which is almost unique in the completeness of the arrangements for the illumination of opaque objects.

The Microscope employed was made by the firm of Zeiss after Prof. Martens' design. It stands on a slide movable in the direction of the optic axis, and is fixed to a cast-iron plate which rests on two fixed points and an adjusting screw, so that the optic axis of the Microscope can be suitably directed. Both the body-tube (50 mm. wide), and the movable stage, which is provided with a coarse- and fine-adjustment, are directly attached to the common support. The extent of movement of the stage is considerable, in order to facilitate the examination of large objects. The stage is of the same form as that in Zeiss' photographic instrument. By means of the usual spring clamp an object-holder can be attached to it, so that in the case of irregularly shaped objects the surface to be examined can be properly adjusted. For the illumination by reflected light several methods are adopted. For weak objectives either a plane parallel glass set at 45° in front of the objective is used, or a prism placed so far forward as to cover one-half of the aperture of the objective. Both arrangements are carried by an adjustable holder attached to the body-tube. For higher objectives illumination from above through the objective is employed. For this purpose the light from a side opening is directed by a prism through one half of the objective so as to fall upon the object which is examined by the other half of the objective. In this arrangement the Zeiss apochromatics 0.30 and 0.95 N.A. (16 mm. and 4 mm. focal length) are used. The prism-holder consists of a small box which can be displaced sideways so as to give the effect of oblique light, or be shifted quite to one side, when the objective can be used with its full aperture for illumination by transmitted light. For the adjustment of the prism at right angles to the optic axis of the illuminating apparatus, a piece is provided which is movable about the optic axis and carries both objectives. This holder with the apochromatics and special prism can be replaced by another with fixed prism into which Zeiss objectives A, B, and D D fit.

Photomicrographical Apparatus of the Leipzig Anatomical School.†—Prof. W. His describes the photomicrographical apparatus which he employs in his embryological and morphological researches. The apparatus is not intended for the more difficult problems of photomicrographical technique, but to answer the more modest requirements demanded by work at comparatively low magnifications. The aim of the author was to produce, under moderate magnification (10 to 200 times), large pictures which could be of service for precise measurements and plastic reconstructions. The work was simplified by dispensing with the glass negative and taking the photographs directly on Eastmann's silver bromide paper. The apparatus first used was arranged

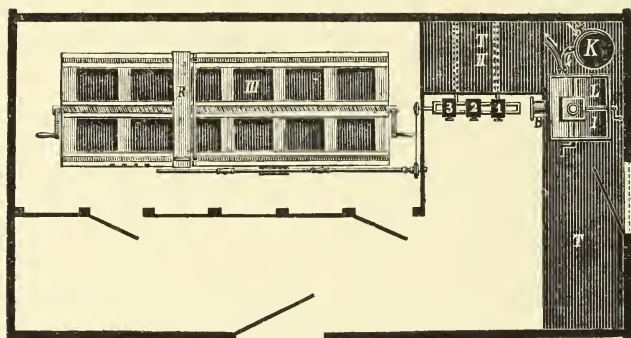
* Central-Ztg. f. Optik u. Mechanik, xiii. (1892) pp. 135-6.

† His, W., 'Der Mikrophotographische Apparat der Leipziger Anatomie' (Festschr. Albert Kölliker zum 26. März 1892), Leipzig, 1892, 22 pp., 3 pls. and 2 woodcuts.

for gaslight, and only admitted of magnifications up to 20 times. The present apparatus, in which the electric light is employed, allows of work at any magnification, from the lowest to the highest attainable with immersion apochromatics.

The general arrangement of the apparatus is seen in the figure (fig. 74) which represents the ground plan of the photographic room. T is the work-table, I the lantern with the electric lamp L, B the first illuminating lens, II the optical bank with slides 1 to 3, K a zinc vessel with water supply for cooling the lantern, III the stand in the dark room, R the photographic frame.

FIG. 74.



The electric lantern consists of a wooden box 95 cm. high, containing a Bürgin arc lamp. In the side wall is a window for the observation of the arc, and in the front wall fits a metal plate, which is movable transversely by screws, and carries a wide tube containing the first illuminating lens. Between lamp and lens is a copper cooling vessel, with glass sides, through which a stream of cold water passes. For centering purposes the lamp can be displaced transversely on a slide by means of a winch worked from the outside. Each of the two carbons is provided with an independent movement. The most advantageous distance for the carbons was found to be 4–8 mm.

The optical bank, 61 cm. long, is provided with prismatic rails, and rests on two iron supports built into the wall of the room. Three slides move on it, the first of which carries the illuminating system, the second the object-stage, and the third the objective. The illuminating system consists of a double lens of 21 cm. focal length. Besides this lens, slide 1 also carries a red glass plate which can be thrown out to one side, and a metal ring for the reception of coloured glass plates.

Slide 2 supports a brass frame on which the object-stage hangs. This stage, which is movable by screws, horizontally and vertically, can be readily put on or off.

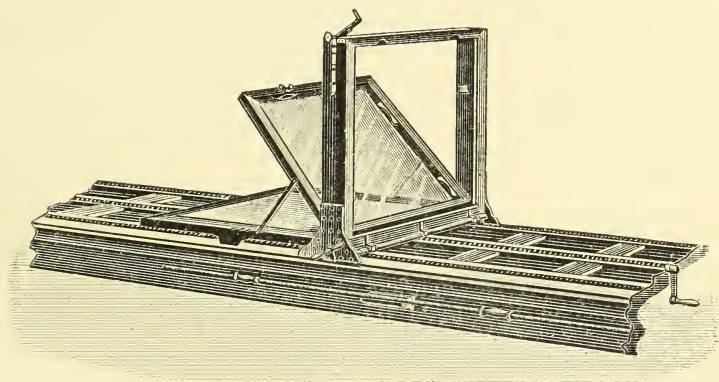
Slide 3 carries a rectangular metal plate in the ring of which the objective is screwed. For high magnifications this objective-holder can be removed and replaced by a large Zeiss Microscope. In front of the objective is a diaphragm which can be thrown out to one side.

Slides 1 and 2 are adjustable by hand. Slide 3, on the other hand, is moved by a screw which can be worked from the interior of the dark room.

The front wall of the dark room, 10·5 cm. from the optical bank, carries the projection aperture with its shutter, besides a loop-hole and a small velvet curtain for protection against reflections. The projection aperture measures 8 cm. in diameter; the shutter is a plate of sheet iron movable about an axis. This plate is covered on its outer surface with white paper, and thus serves for the proper adjustment of the light, for it is easy to recognize on the plate whether the light is evenly distributed or whether coloured edges, &c., are present. The space between objective and projection aperture is covered by a velvet cloth.

The photographic frame (fig. 75) is moved by a winch along two racks on a support, 2·1 m. long and 0·95 broad, fastened to a fixed stand in the dark room. For the author's purpose of obtaining large photographs directly on paper the following arrangement was employed. Two thick glass plates, 80 cm. square, are fitted into two wooden frames in such a way that they can be brought almost into immediate contact, so that a sheet of paper can be held firmly between them. The two frames are fastened together by two screws with bayonet catch. The vertical position in the main frame is marked by a stop. The hinder glass plate is covered in front with white paper on which the adjustment is made.

FIG. 75.



For the purpose of reducing the intensity of the electric light the author uses coloured glasses, and almost exclusively dark yellow ones.

The times of exposure in the author's experiments varied from 10 seconds as a minimum to three minutes as a maximum, but were mostly from 30–60 seconds. For magnifications up to 200 or 300 the objective alone was sufficient, for higher magnifications the large Microscope-stand and projection eye-piece of Zeiss were used.

As regards the choice of the systems, the author, from the experience of several years, considers that for low magnifications the Steinheil aplanatics leave nothing to be desired. He uses for magnifications of 4–15

times the aplanatic of 14 cm., for 8-25 times that of 7 cm. focal length. Many of the Hartnack systems, however, are not inferior to these. For magnifications of 20-55 Hartnack's embryograph was found to be the best. For medium magnifications of 50-300 times the Seibert systems of 1, 1/2 and 1/4 in. were used, and for magnifications above 300, the Zeiss projection eye-piece with the dry apochromatics of 8 and 4 mm. focal length.

With high magnifications a difficulty was experienced with respect to the clamping of the preparation on the object-stage. Owing to the unequal pressure of the two clamps the preparation was not at right angles to the axis of the Microscope. This difficulty was removed by attaching to the stage a plate which could be levelled by screws. The clamps, three in number, were screwed to this plate, and their pressure on the object-slide was thus regulated.

The course of the operations for low or medium magnifications is as follows. After fixing the objective and closing the current in the electric lamp, the magnification is determined. For this purpose a small glass scale divided in half or tenth millimetres is adjusted on the stage of slide 2, and the frame in the dark room is moved until the desired magnification is obtained. The proper illumination is then considered. The first illuminating lens (20 cm. focal length) in the lantern is once for all adjusted so that the rays fall approximately parallel and fill the aperture of the second lens on slide 1.

This slide is then displaced until the point of the pencil of rays falls in the plane of the diaphragm of the objective.

The preparation is now placed on the stage, and the fine-adjustment is made from the dark room. The current is then broken and the two shutters and the front door of the dark room are closed.

The plate-frames are then laid down and the sensitive paper inserted between them. The current is once more closed and the light regulated by examination of the white paper in front of the shutter. To ascertain whether the image falls properly on the sensitive paper the red glass screen is placed before the illuminating lens of slide 1, and the shutter is opened, while the object-stage is adjusted. The shutter is then closed again, the red glass removed, and the light again adjusted. Exposure is then effected by opening the shutter.

To adjust the apparatus for use with the Microscope-stand, the objective-holder is removed and space cleared for the stand. The Fritsch's wheel on the slide is then connected by an intermediate piece with the guide in the dark room, and the diaphragm-holder of slide 3 is adjusted. The Microscope is now screwed upon the slide and directed horizontally. The Fritsch's wheel is raised until it engages in the micrometer screw of the Microscope. To insure the proper centering of the light the aperture of the iris-diaphragm is made very small, and the illuminating lens and carbons are moved until the point of the pencil of rays falls just in this aperture. For the later orientation on the direction of the pencil of rays a second diaphragm in the diaphragm holder is used. The circle of light is made concentric with the aperture of the diaphragm.

After the centering of the light, the iris diaphragm is opened, and by means of the large illuminating lens and Abbe condenser the proper

illumination of the object is determined. The other operations are as before.

Of the three excellent plates in photogravure at the end of the book, prepared by Riffarth of Berlin and Albert of Munich, the first gives a perspective view of the optical bank and its connection with the lantern and front wall of the dark room. The second and third are photographs of sections taken on Eastmann paper. Plate II. is the frontal section through head and neck of a human fœtus of the fourth month ($\times 9$). Plate III. is a section through the spinal column of a four weeks' human embryo ($\times 210$).

Use of Photography in Natural Science.*—Prof. G. Marktanner-Turneretscher discourses on the various ways in which photography can assist in scientific work. He first takes the case of museums and scientific institutions, and points out how useful for the zoologist photographs of rare and type specimens would be. More especially serviceable would be photomicrograms of minute specimens. Whole groups, such as the Protozoa, which are too small for exhibition, could thus be brought to the notice of the public. Such photomicrograms would be also of great assistance to the scientist himself, since they can be compared with other specimens &c., without the necessity of bringing the object itself again under the Microscope. If each scientific worker had photographs of his species arranged as a catalogue the task of comparison of new with already known forms would be considerably simplified, and many synonyms would in this way be avoided. As regards the palæontological departments of a museum, the less perfect specimens should be accompanied by photographs of the more perfect individuals which had been figured.

The value of photography and more especially of photomicrography to the histologist and embryologist is seen in the constant use which they make of it, as shown by the numerous photographic plates which invariably illustrate their published works.

In botanical researches photography has also been of the utmost service, as, for example, in the recent investigations of Paul Knutt on the fertilization of flowers by insects. He found that certain flowers with little colour produced a considerable effect on the sensitive plate. He explains this as due to the reflected ultra-violet rays, and considers, from the fact that such flowers are sought after by insects, that the insect eye is sensitive to these rays.

In mineralogy and petrology photomicrograms of sections in ordinary and polarized light are of great use. Each rock specimen exhibited in a museum should be accompanied by a photomicrographical representation of its section.

In teaching establishments photography is more particularly of service by the methods of projection.

The author concludes with advice as to the most suitable photographic apparatus to be used for different purposes. As regards photomicrography he recommends the use of Zeiss' apochromatics and projection eye-pieces for work with high magnifications.

* Mittheilungen d. Section f. Naturkunde des O. T.-C., iv. (1892) pp. 33-5 and 41-44.

(5) Microscopical Optics and Manipulation.

Abbe's Method and Apparatus for the Determination of Focal Lengths.*—Dr. S. Czapski gives a detailed account of the methods and apparatus recently devised by Prof. Abbe for the determination of focal lengths,† and explains the principles on which they depend. By the Abbe method, the fundamental conditions necessary for “micrometric measurements by means of optic images” are more fully satisfied than by any other previously employed; and accordingly the influence of the systematic as well as the accidental errors of observation on the result are considerably minimized. These fundamental conditions, as formulated by Prof. Abbe, are as follows:—

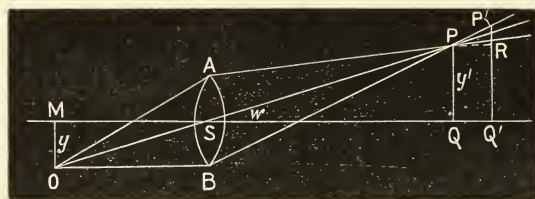
(1) A determination of precision must not be made dependent upon the position of the optic image.

For this position is always uncertain. The amount of play in an adjustment is directly proportional to the keenness of the observing eye and inversely to the angular aperture of the pencil forming the last image in front of the eye. For a normal eye the amount of play amounts to about 13 mm. For an eye armed with a lens this source of error is considerably increased. In the determination of the focal length of optical systems therefore, the distance of one image from another or from a fixed point must not enter in as a factor.

(2) The measurement must not be indirectly affected by the adjustment.

Suppose, for example, that the magnitude of the image $PQ = y'$ formed by the system S of the object OM is to be measured, and that

FIG. 76.



an error in adjustment $QQ' = dx'$ has been made; then the amount of error in the measurement of PQ is $RP' = QQ' \tan \angle PSQ$, i.e. $dy' = dx' \tan \omega$.

The error involved in calculating the magnitude of the object from that of the image is then

$$\frac{dy}{y} = \frac{dx' \tan \omega}{Ny}$$

where $N = y'/y$ is the linear magnification.

A means of reducing the error is to diminish the angle PSQ , which the axis of the pencil forming the image makes with the axis of the

* Zeitschr. f. Instrumentenk., xii. (1892) pp. 185-97.

† See ante, p. 427.

system. Prof. Abbe makes the angle zero by the use of a sufficiently small diaphragm in the front focal plane of the system, the effect of which is to make the system on the side of the image "telecentric," i. e. the axes of all the pencils emerging from the system, as seen in fig. 77, are parallel to the axis of the system.

(3) The third requirement in any method of precision depends on the following considerations:—

It is in the nature of dioptric systems that in general the images are not in all parts proportional to the objects, but that the ratio of the

FIG. 77.



magnitudes of the two is a function of their dimensions. For this reason, if conclusions on the fundamental properties, e. g. the focal length, are to be drawn from the magnification which a system has in any two conjugate points, only a very small central part of the image must be used in the measurement. On the other hand, however, the measurement of the magnification is always more exact, the greater the object and image.

The simplest way to satisfy these somewhat conflicting requirements is to take several measurements on large images, gradually diminishing in size, and from the result of these relatively exact measurements, to calculate the fundamental value of the magnification, i. e. that value which would be found for the infinitely small central part of the image. The author shows how these three requirements are fully satisfied in the Abbe method for determining focal lengths.

In this method, the determination of the focal lengths depends upon the magnifications which the system gives of two objects at a determined distance apart.

If f is the focal length of the system, N_1 the magnification for one pair of conjugate points, N_2 that for another pair, and a the distance of the object planes apart, then (fig. 78)

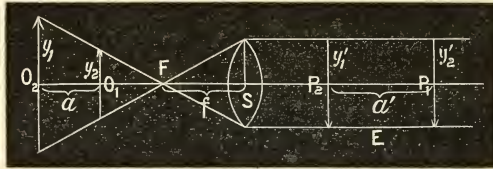
$$f = \frac{a}{\frac{1}{N_1} - \frac{1}{N_2}}$$

Two exactly divided scales in O_1 and O_2 serve as objects. The first requirement is satisfied by the fact that it is the distance of the objects and not that of the images which has to be measured.

In order to satisfy the second, a small diaphragm may be brought into the front focal plane F of the system, and measuring arrangements, for determining the magnitude of the images, in the planes P_1 and P_2 , behind the system.

None of the measuring arrangements, however, at present known would sufficiently satisfy the third requirement by presenting a large enough part of the image for measurement. To obviate this difficulty a micrometer-Microscope may be made to move parallel to itself, and to the axis of the system from one end of the image to the other, e. g. from the ray E to the ray G. Different parts of the image are thus brought

FIG. 78.



into the field of view, and the magnitude of the displacement required in order to bring certain parts of the image into a determined part of the field, is equal to the distance between those parts of the image. When the micrometer-Microscope is provided with cross-wires in the eye-piece, a further simplification follows. For if the axis, i. e. the line joining the centre of the cross wires to the hinder principal focus of the micrometer-objective, is parallel to that of the system to be measured, and keeps parallel to it during the displacement at right angles to that axis, then only pencils, the axes of which are parallel to that axis, come to a focus. Thus by this arrangement the telecentric path of the rays is obtained without the necessity of inserting a diaphragm in the front focal point of the system.

An arrangement however to effect the exact parallel displacement of the Microscope, if technically possible, would render the instrument costly and perhaps detract from its functional exactness. To avoid this, Prof. Abbe, instead of making the measuring arrangement (the Microscope) displaceable with respect to the objective, has made the latter movable at right angles to its axis and parallel to itself, while the Microscope and scale remain fixed. The displacement Y of the objective necessary to pass from the image of one point of the object to another is then the magnitude of the image; the magnitude of the object to be compared with this is equal to this displacement, minus the real distance y of the two points of the object which were successively adjusted, i. e. to $Y - y$. If then β_1 and β_2 denote the reciprocals of the magnifications N_1 and N_2 , we have

$$f = \frac{a}{\beta_1 - \beta_2} \text{ where } \beta_1 = \frac{Y_1 - y_1}{Y_1}, \beta_2 = \frac{Y_2 - y_2}{Y_2}.$$

The apparatus itself (figs. 79 and 80) is essentially a large Microscope. Almost the only difference is that in the lower part there is a metal frame for the reception of a glass scale T . A second more finely

FIG. 80.

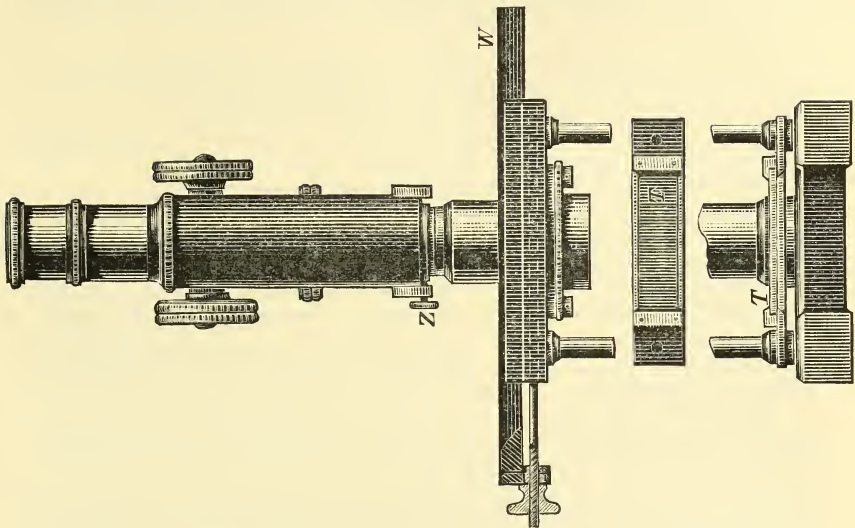
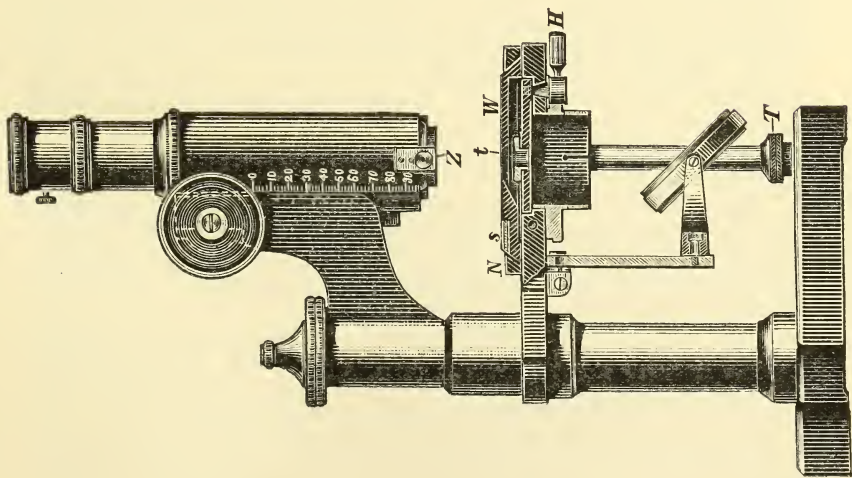


FIG. 79.



divided scale t is fitted just beneath the stage, and can be moved backwards and forwards by a small lever H. Its central position is marked by a stop.

Dovetailed in the stage of the Microscope is a plate W, movable from right to left, and carrying on the edge nearest the observer a division on silver s with a vernier N reading to 0.05 mm.

The glass scale T is divided in $1/2$ mm.; the scale t , in the central portion of 2 mm. length, in 0.05 mm.

The body-tube has the usual coarse- and fine-adjustments.

The draw-tube carries a millimetre division, giving the total tube-length. For use with the apparatus there are five objectives, numbered 1-5, and an eye-piece, with removable optic lens, in the diaphragm of which either a double cross wire or a micrometer scale (10 mm. divided in 0.1 mm.) can be fitted. The objectives are screwed to the body-tube, and centered by means of the arrangement movable by the screw Z. The eye-piece simply slides into the body-tube, and is clamped in position by a screw.

The height of the tube-support above the stage is 50 mm., so that measurement can be made of systems of this height, and with a diameter of 100 mm.

As at present constructed, the apparatus serves for the measurement of systems of somewhat more than 80 mm. focal length, and of about 20-100 mm. aperture.

In making an observation with the instrument, the objective 1 (of shortest focal length) is first used, and the cross wire in the eye-piece is arranged with the double wire from front to back. The Microscope is then adjusted on the scale t , which is illuminated by the mirror beneath the stage. The objective is centered so that the middle division of the scale appears between the double wire in the eye-piece, and the position is noted in which the horizontal cross wire cuts the micrometer division. The movable plate of the stage is then displaced until the zero of the vernier points to the middle division of the scale s .

The system S to be measured is now placed on the scale t , and is moved, while the Microscope is again adjusted on the scale, until the same mark of the scale t appears between the double wire of the eye-piece, and the horizontal wire cuts the image of the division of t at the same height as before.

The plate W is now moved from the central position to the right until a certain division of the scale t appears between the double wires of the eye-piece, and the Microscope is readjusted on the scale. A reading is then taken on the vernier of the scale s , and the distance of the division of t from the central division noted.

The plate W is now displaced to the opposite side of the central position, to the left, until the corresponding division of the scale as before, only on the other side of the middle division, is adjusted in the eye-piece. The displacement of the scale s is again noted.

The same processes are then repeated for the scale T, which is rendered visible by the removal of the mirror and the upper scale. The objective 1 is in this case replaced by one of the lower ones chosen by trial.

Let y_1 and y_2 denote, for the two scales respectively, the distance of

the two divisions adjusted by the movement from right to left, and Y_1, Y_2 the displacements of the scale s , then, since

$$f = \frac{a}{\beta_1 - \beta_2} \text{ where } \beta_1 = \frac{Y_1 - y_1}{Y_1}, \beta_2 = \frac{Y_2 - y_2}{Y_2},$$

we have

$$f = \frac{a}{\frac{y_2}{Y_2} - \frac{y_1}{Y_1}}.$$

The Dioptric Conditions for the Measurement of Optic Axial Angles by means of the Polarization Microscope.*—Dr. S. Czapski lays down the following conditions in the determination of the optic axial angles of crystals:—

- (1) The condenser system must have an aperture at least as large as that of the objective.
- (2) The crystal plate must be parallel.
- (3) The relation between the axial angles of rays in a pair of conjugate points O and O^* of the objective must be known.
- (4) At O must be the crystal plate, and at O^* the eye.
- (5) It is best to use an aplanatic eye-piece, and to make the path of the rays of the auxiliary Microscope “telecentrisch.”
- (6) For measurement with different wave-lengths the objective must be achromatic, i. e. spherically chromatic, and corrected for the whole visible spectrum.

Geometrical Representation of the Formula for Lenses.†—M. D'Ogagne states that by a well-known construction the magnitudes occurring in the formula

$$\frac{1}{p} + \frac{1}{p^1} = \frac{1}{f}$$

may be represented by the distances in which a straight line rotating about a fixed point cuts two rectangular axes, and the distance of the centre of rotation from the centre of the co-ordinates. He remarks that this construction is more convenient if the axes are taken as intersecting at an angle of 120° instead of 90° .

Rings and Brushes.—Mr. E. M. Nelson read the following note at the April meeting:—It is a curious fact that nowhere in microscopical text-books is any account given of the method of viewing the rings and brushes which certain minerals show under polarized light.

There are perhaps some microscopists who, thinking that such objects can only be seen with a petrological Microscope, and having no desire to prosecute deep research in that direction, and being unwilling to purchase a petrological Microscope, are content to shelve the subject. Now as these beautiful objects are within the reach of all those who have an ordinary microscopical outfit, I thought it worth while to bring before the Society an explanation of a simple way of seeing them.

If you set up your instrument as if for viewing ordinary polariscope objects, not a ring or a brush will you see.

The whole point lies in the fact that it is a wide-angled telescope you require and not a Microscope at all. Once this is recognized the

* Zeitschr. f. Wiss. Mikr., ix. (1892) p. 130.

† Central-Ztg. f. Optik u. Mechanik, xiii. (1892) p. 116.

whole thing becomes simple enough. As the Microscope has to be turned into a wide-angled polarizing telescope, all that is necessary is to screw a low power on the end of the draw-tube. As the light requires to be passed through the crystal at a considerable angle a wide-angled condenser should be employed, but it need not be achromatic. The objective I found most suitable was a $4/10$ of $\cdot 64$ N.A.;

but a $1/4$ of $\cdot 71$ N.A., or a $1/3$ of $\cdot 65$ N.A. will do equally well. As the whole of the back lens of the objective should be visible through the analysing "Nicol" the back lens of the objective must not be too large, thus a $1/2$ in. of $\cdot 65$ N.A. would not do so well. The analysing prism may be placed either where it is in the drawing or above the eye-piece. Practically it works very well above the objective, which is the position it occupies in "ordinary microscopical outfits."

For the draw-tube a 2 in. objective and a B or C eye-piece will be found to answer admirably.

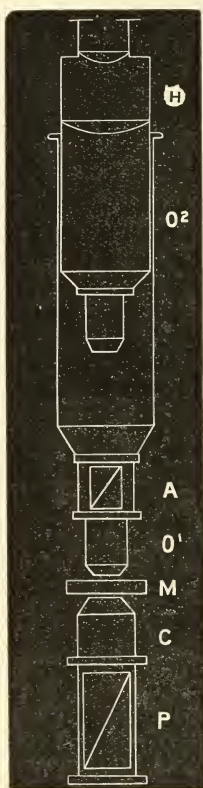
To set up.—Before screwing the objective in the end of the draw-tube, centre the light in the usual manner, the "Nicol's" being turned so as to give a light field. Next fix the objective in the end of the draw-tube, open the substage condenser to full aperture, and put the mineral on the stage. Rack down the body so that the objective on the nose-piece nearly touches the crystal, then focus with the *draw-tube* exclusively. The substage condenser should be racked up close to the under side of the crystal.

(6) Miscellaneous.

Microscopes and Accessories at the Antwerp Microscopical Exhibition.*—Dr. R. H. Ward, in his Presidential Address to the Microscopical Section of the Troy Scientific Association, said:—"In this department the chief exhibitors were, naturally, the manufacturers, and with only two notable exceptions they were of the 'Continental' group.

Among the whole it was evident that one, the Carl Zeiss establishment at Jena, was easily pre-eminent, on account of the magnitude and variety of its exhibit, the high quality of its work, and the extent and importance of its contributions to recent development of the Microscope, especially in inventing and introducing new optical glasses of high refractive indices and in the creation of the apochromatic objective. The exhibit included a large variety of the well-known Zeiss stands, with

FIG. 81.



In substage: P, polarizing prism; C, substage condenser. On stage: M, mineral. On nose-piece: O¹, objective $4/10$ $\cdot 64$ N.A.; A, analysing prism. In draw-tube: O², objective, 2- or 3-in.; H, Huyghenian eye-piece.

their different classes and powers of oculars and objectives, and their outfit of numerous and ingenious accessories; also a special stand for

* Amer. Mon. Micr. Journ., xiii. (1892) pp. 136-40.

photomicrography, a complete special photomicrographical apparatus that is small and portable, and another of great size furnished with a Schuekert electric lantern and the most elaborate appurtenances of various kinds. But the most interesting feature of their exhibit was a demonstration of the construction of a large stand and of an apochromatic objective and a compensating ocular. All the pieces entering into the construction of a No. 1 stand were displayed spread out in a case, like a picture against the wall, each piece being given in duplicate, once in the rough casting or section of tube or wire, and again in the finished form ready for assembling into the completed instrument. In another case were superb blocks of the new optical glasses of Drs. Abbe and Schott of Jena, and of the fluorite of the Oltseheren Alp. The different stages in the construction of an 8 mm. apochromatic objective and of a compensating ocular were also displayed in proper series, all the lenses entering into the combination being shown both in the rough and the finished state. Probably every visitor would have voted with the jury in awarding the one special prize, the diploma of pre-eminence, to the Jena Company.

Next to this, three grand prizes were given, which went to London, Paris, and Germany, respectively. The English one was bid for by a solitary stand, with two or three objectives and condensers at its feet, that looked so lonesome, not to say insignificant, that to claim a leading prize for it seemed almost presumptuous. Its appearance, amidst the neighbouring cases crowded with showy apparatus, suggested at once the quiet home from which it came in Euston Road, in contrast with the showy shops where such goods are commonly displayed. But the stand made a strong competition for its not too modest claim, to be the most perfect that is made, the apochromatic objectives were judged to merit their high reputation, and the apochromatic condensers were found to give a singularly perfect illumination, and a *grand prix* was awarded to Powell & Lealand.

Prizes of like grade were well earned by, and awarded to, A. Nachet of Paris, and to E. Hartnack, originally also of Paris, but since the Franco-German war, now of Potsdam, Germany, both of whom exhibited a large variety of apparatus of the very highest grade, including excellent apochromatic objectives and sumptuous photomicrographic apparatus.

Of the many creditable exhibits of a somewhat more modest grade, at least in respect of prices, by far the largest was that of Wm. Watson & Sons, of London. In fact, it was one of the most interesting and commendable features of the exposition. It stood alone, except for the single P. & L. stand, as the sole representative of the English ideas and styles, while everything around it was Continental, wholly Continental. These makers, also, in developing some of their most practical stands, have made such large and good use of American ideas and experience that we are half inclined to claim a special interest in the result. We have been much interested in their efforts during recent years to develop and improve the simple and less expensive forms of Microscopes, especially in rendering the English and American type convenient and available for laboratory use, and in building up in London well-organized shops (after the method characteristic of American practice) where work of a uniformly good quality can be done by machinery at a moderate cost. Perhaps the most universally available of their more ambitious

instruments, though fortunately far from the largest or most costly, is the one lately arranged from Dr. Van Heurck's suggestions and named after him. Though of moderate size and cost, being of exactly the size that the writer would choose as a maximum, this possesses a great number of serviceable features; and, notwithstanding the unfavourable opinions that some eminent authorities have expressed on theoretical grounds, its practical working seems excellent. The jury especially complimented 'the extreme precision of all its movements:' and the writer found it unexpectedly easy with its fine-adjustment to focus a lens of N.A. 1.63 upon the shell of *A. pellucida*, adjusting it instantly to exactly the plane of clearest vision of the dots, and leaving it there, though every one knows that, with extreme powers, it is often easy to catch glimpses, in passing, of points which can hardly be permanently focused upon and shown to other observers.

One of the strongest and most agreeable impressions made by the manufacturers' exhibit, in the aggregate, is that of the uniformity in good workmanship, and of the variety of convenient and tasty designs, by all the prominent makers.

All the manufacturers, with two exceptions, already stated, are of the Continental sort, and never before has the writer seen grouped in one room a representative collection of their Microscopes at all comparable to this. It is most interesting to note the purity in which, in so many hands, their type of stand has been preserved and the extent to which its possibilities have been developed. This style must be abundantly satisfactory, alike to the manufacturers and to their patrons, to be so freely reproduced and elaborated by so many ingenious workers, in so many diverse places, with so little deviation from the prevailing type. The interest of the display is doubled, to Americans, from the fact that from the first we have been constantly presented with the choice between adopting the English or the Continental style as the basis of our own. The friendly though often severe battle of the stands has continued throughout the memory of the present generation, and still continues to some extent notwithstanding the evident fact that the English type has entered by far the most largely into our experience thus far. Without forgetting that where the wisdom and experience of continents are concerned, the opinions of single individuals are of little importance, the writer could not do justice to the title of this paper without giving his 'impressions' on this very interesting phase of the subject. While a user of the English style for more than thirty years, and naturally with strong prepossessions in its favour, and still satisfied with it, he must admit that the neat and unpretentious Continental stands of the smaller and more simple grades become more attractive with every increase of acquaintance. It would be difficult to find anything more tempting or practical for student's laboratory work (exclusively) than the beautiful little stands exhibited by all the French and German makers, though some of the small American and English stands still seem to be equally available. On the other hand, the larger stands of the Continental type, with elaborate adjustments and numerous accessories, always produce the feeling that, notwithstanding their ingenious designs and great efficiency, they are unfortunately clumsy and somewhat overloaded, their traditional com-

compactness being maintained at the cost of some unnecessary inconveniences. The possibilities of the English-American stand seem to be not yet realized on the Continent; but the writer will venture the prediction that there will be a revolution in this respect some time before the next tricentennial. The reaction has evidently commenced already in respect of accessories and incidental refinements of detail. Such microscopical aids and comforts as mechanical stages, elaborate substages and substage condensers, iris diaphragms and rapid nose-pieces, which we have been using for a generation, more or less, with great satisfaction, but which we have meanwhile heard constantly denounced by partisans of the Continental method as needless luxuries and distracting toys, all these we now see introduced and given a proper prominence by the best Continental makers. 'Tis well.

As to objectives, the progress of the present day evidently centres around or stands in comparison with, the apochromatic system. Of the success of the system there is no longer a reasonable doubt, either as a scientific or as a commercial question. Characterized by the employment of new varieties of glass, of extraordinary optical properties, manufactured at Jena, and by the substitution of fluorite (natural fluor spar) for crown-glass in several of the lenses, it corrected spherical and chromatic aberration to an extent not before attained. Brought into existence by the researches and experiments of Abbe and Schott, and first successfully introduced at the Zeiss factory, in 1884, it is now adopted for their highest grades of objectives by all the above-named makers, except perhaps Watson; and new series or varieties are being constantly introduced.* The resolution of *Amphipleura pellucida* in dots, which has been ably disputed and may be still doubted by some competent judges, is well within the limit of their capacity. The writer was fortunate in being afforded the rare privilege of witnessing the official trial of the objectives by the jury, at which time the Zeiss 1/10 (2.5 mm.) of N.A. 1.63, with monochromatic sunlight illumination, showed the dots (or 'beads') with beautiful distinctness and with perfect ease. They were seen at a glance over a large part of the shell at once, always alike and with remarkable freedom from any suspicion of uncertainty; and when lost by change of focus or even by carrying the instrument to another table and readjusting the light, they could be recognized instantly, and every time, by simply correcting the fine-adjustment. As the most oblique pencils able to be utilized by this objective, as employed, ought, according to the Helmholtz theory, to be able to resolve lines of about 6000 to the millimetre, and as the *A. pellucida* had about 3700 rows of the dots transversely and 5000 rows longitudinally, to the millimetre, this resolution, while near enough to the theoretical capacity of the lens to give an impressive demonstration of a near approach to perfection in the construction, yet does not, by exceeding its theoretical capacity, throw discredit upon either the genuineness of the resolution or the accuracy of the optical theories involved.

But the durability of the apochromatics is, most unfortunately, not equally plain. It is said that those first made were unsafe, from the

* Near the close of the exposition, after the report on awards was adopted and closed, a new 1/12 (2 mm.) was received from Nachet and informally examined by the jury with the result of calling out from them a special note of commendation.

ease with which changes occurred in the frail phosphate and borate glasses causing the dimness known as the disease of the apochromatics. This was always freely corrected without charge by the makers, and it is believed that the glass as now made is free from this defect. The fluorite, however, must be taken with its natural defects; and its easy cleavage renders it very fragile. In fact, it is now known that, more than thirty years ago, Charles A. Spencer, of Canastota, N.Y., recognized its tempting optical properties, and used it in the construction of objectives, one of which is still in existence; and that he abandoned the method because of the early deterioration from the cracking of the spar. That now used in the apochromatics is not only clearer and remarkably free from colour, but is evidently more durable, and, it is hoped, practically permanent. The lenses are, however, absolutely limited in output, as the world's supply of suitable spar is confined to the stock now in hand, with no known means of replenishing it. It is, therefore, none too soon to be finding some method of making high class work without it; and this is being attempted, with encouraging success, by several makers, in the construction of the semi-apochromatics, made from the new optical glasses, but without the fluorite. Though not quite as free from colour as the apochromatics, their views are very distinct, and their working qualities extremely good. The resolution of *A. pellucida* in 'beads' by a semi-apochromatic is claimed to have been accomplished in Italy."

The Microscope's Contributions to the Earth's Physical History.*
—Prof. T. G. Bonney, in the Rede Lecture for 1892, takes for his text the progress in geological research which has been directly due to the revelations of the Microscope. By the side of the epoch-making discoveries of Darwin and Wallace, Bunsen and Kirchoff, he places the work in a humbler and more limited sphere of Sorby, who, in 1856, first described the results of microscopic investigations into the structure of minerals and rocks. The method employed by Sorby was, strictly speaking, not novel, for years before, in 1827, William Nicol of Edinburgh had made sections of fossil wood sufficiently thin for microscopical examination. The device, however, had not been generally applied, and to Sorby is due the credit of first pointing out its wide possibilities.

Before telling the story of microscopical research into the history of the earth's crust, the author indicates briefly the mode in which the Microscope is used in the examination of minerals and rocks. Slices are first cut by the lapidary's wheel thin enough for most of the minerals to become translucent, if not transparent. These are then examined under a Microscope of special construction, furnished with Nicol's prisms and other optical appliances.

Upon the history of the two main groups of rocks the Microscope has thrown much light. For the igneous rocks it has simplified the classification and determined the mutual relations; while for the sedimentary group it has shown the true nature of their constituents and pointed out the sources from which they were derived. But it is in helping to elucidate the problem of the metamorphic rocks, of which much less was known, that the Microscope has been of the most service.

* Nature, x'vi. (1892) pp. 180-4.

The author deals at length with this portion of his subject, and shows how the Microscope has assisted in the attempt to determine the history and mutual relation of these rocks. One of the most important results within the last few years has been the demonstration that without exception these crystalline schists are very old, all probably older than the first rocks in which traces of life have been found. The conclusion at present arrived at is that "the environment necessary for changing an ordinary sediment into a crystalline schist existed generally only in the earliest ages, and but very rarely and locally, if ever, since Palæozoic time began."

The crystalline schists then are the relics still preserved to us of the early days of this earth's history when the temperature near the surface was still very high. Since that time the zone for marked mineralogical changes has been continually sinking until at the present day it has reached a depth practically unattainable. "The subterranean laboratory still exists, but the way to it was virtually closed at a comparatively early period in the earth's history."

In conclusion the author considers that the progress made since the Microscope was pressed into the service of geology augurs well for the future, and inspires the hope that we shall at last learn something of the history of the earliest ages "when the earth had but lately ceased to glow, and when the mystery of life began."

B. Technique.*

Microtechnique of Vegetable Objects.†--Dr. L. Klein describes at length some points in the technique of vegetable histology, and considers them under the heads of imbedding in celloidin and paraffin, the media suitable for mounting, and the most convenient staining solutions.

For celloidin imbedding, the object having been thoroughly dehydrated by immersion in absolute alcohol in a Schulze's dialyser, is soaked for 6-10 hours in a mixture of equal parts of ether and absolute alcohol. The piece, the sides of which should not exceed 3-5 mm. long, is then placed in a thin solution of celloidin (about 5 per cent.) in equal parts of ether and absolute alcohol. In this solution, contained in tightly stoppered bottles, the object remains for at least three days. After this time the celloidin solution is thickened by slow evaporation of its solvents, and this is effected first by substituting a cork for the glass stopper, and afterwards by inserting strips of paper between the neck of the bottle and the stopper. It is finally inspissated by direct evaporation, and then by immersion in 60 per cent. spirit. The celloidin block, the section surface of which should not exceed a square centimetre, is fixed on cork or wood by means of a thin layer of celloidin solution of the consistence of syrup.

The surface of both the cork and section block should be previously moistened with ether, and the two parts having been tightly squeezed together, the mass will be sufficiently adherent in 10-15 minutes for

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† *Jahrbücher f. Wiss. Botanik* (Pringsheim), xxiv. (1892) pp. 1-57.

cutting. Instead of squeezing the two—cork and block—together, they may be fused firmly by immersing them in 60 per cent. spirit for about a day. All the foregoing steps are to be carried out in glass vessels, but the formation of the section block by pouring a thickish solution of celloidin into paper cases, and then, having properly oriented the object, hardening the mass by immersion in 60 per cent. spirit, is also advised. In any case the consistence of the celloidin block should be about equal to that of cartilage.

In sectioning an object imbedded in celloidin, it is necessary to use an immersion microtome, or, at any rate, to employ some means for keeping the knife moist. This may be effected by a dropping apparatus filled with 60 per cent. spirit. It is not at all necessary to remove the celloidin from the sections, and these, after they have been mopped up with blotting-paper, are easily made to adhere to the slide by exposing them to ether vapour.

The further treatment of the sections depends on whether they are to be mounted in an aqueous or resinous medium. In the former case the dilute spirit is removed by immersion in water; in the latter by treating them with 90 per cent. spirit. The author's remarks on paraffin mostly refer to the treatment of sections which have been imbedded in paraffin. He advises that all manipulations should be carried out on the slide on which the sections are to be deposited on removal from the knife. The technique of these steps is, of course, the same as that usually adopted; the paraffin having been dissolved out, the ultimate treatment of the section will depend on the character of the medium in which the section is to be mounted. The mounting medium may be aqueous or resinous, and if the former, then it may remain fluid (acetate of potash, chloride of calcium solution), or may set (glycerin jelly), while resinous mounts require the preparation to be dehydrated. Hence the effect on the section will vary much, and, therefore, which course of the three should be adopted must be decided by the nature of the tissue in the section.

Different kinds of mounting media are then passed in review and the first mentioned are chloride of calcium and acetate of potash, both of which are pronounced to be suitable for delicate parenchyma and for tissues rich in protoplasm, but the use of these fluids is to be avoided, owing to the extra trouble such preparations involve. Glycerin jelly receives commendation, as it may be used for stained objects, does not require to be perfectly cleared, nor to be ringed round. Media, the principal constituent of which is gum, are then discussed: of those noticed may be mentioned Farrant's medium (of which the author admits his practical ignorance) and Hoyer's media, one of which, made of gum, chloral hydrate, and glycerin, is intended for preparations stained with logwood and carmine, while the other is composed of gum and acetate of potash solution. Both these fluids are of the consistence of thick syrup, and as they dry at the edge, ringing round the cover-glass is not necessary.

Resinous mounting media are colophonium, dammar, and balsam, the first two of which are best dissolved in turpentine, as too volatile solvents are inadmissible on account of the crystalline structure of these resins. Colophonium does not appear to possess many advantages, although one may be mentioned: it is little sensitive to a residuum of

water, and therefore complete dehydration is not absolutely necessary. With regard to dammar and balsam, it is only necessary to say that the latter is probably the more useful, owing to its high refractive index, although there seems little to choose between the two media. For this technique balsam is dissolved in chloroform xylol or turpentine, dammar in benzol, or xylol.

For staining vegetable tissue, Bismarck brown holds a prominent place: a small quantity of this pigment is shaken up with spirit, and half the bulk of water added. Only a clear filtrate must be used. This solution is allowed to act for $\frac{1}{2}$ –3 minutes, and appears to give great satisfaction. The next pigment is safranin: the solid pigment is dissolved in spirit, and an equal volume of water added.

Alum and borax carmine are then discussed, both of them are made up according to Grenacher's formula: both have their merits, but the latter has to be differentiated with an acid solution.

Delafield's alum hæmatoxylin also is extremely serviceable and easy of manipulation, and if over-staining occur, the excess is easily removable by means of a faintly acid solution. Notwithstanding the contrasts developed by the use of different pigments or the appearance of different shades, indicating the differences of chemical reaction or of structure, the author advises that these should be compared with unstained sections mounted in the gum and acetate of potash solution.

(1) Collecting Objects, including Culture Processes.

Apparatus for Cultivating Anaerobic Micro-organisms on Solid Transparent Media.*—Dr. A. Trambusti describes an apparatus which he has devised for cultivating and examining anaerobic microbes.

It is made of glass and consists of two parts, the lower of which resembles an inverted funnel while the upper one is cylindrical. In the latter are two openings, the top one tightly closed with a stopper while that at the bottom is very small. Inside the cylinder is a smaller one which is in communication with the funnel-shaped flask or lower portion of the apparatus. The apparatus is used as follows:—The medium, already inoculated, is spread on the bottom of the flask and then this is closed by placing the cylinder on it. Into the latter is then poured as much of the ordinary pyrogallate of potash solution as may be necessary to absorb all the air in the apparatus. The stopper having been put in, the whole apparatus is placed in the thermostat. Two grm. of pyrogallate acid to 15 ccm. of 1 in 10 potash solution are sufficient to extract all the oxygen.

Colonies of anaerobic micro-organisms are said to thrive very well in this apparatus and are quite easily isolated. The apparatus has the further advantage that the growth of the colonies is easily examined through the thin bottom and their shape studied just as in Petri's flasks.

If the pyrogallate solution be shaken up occasionally the absorption of the oxygen is accelerated.

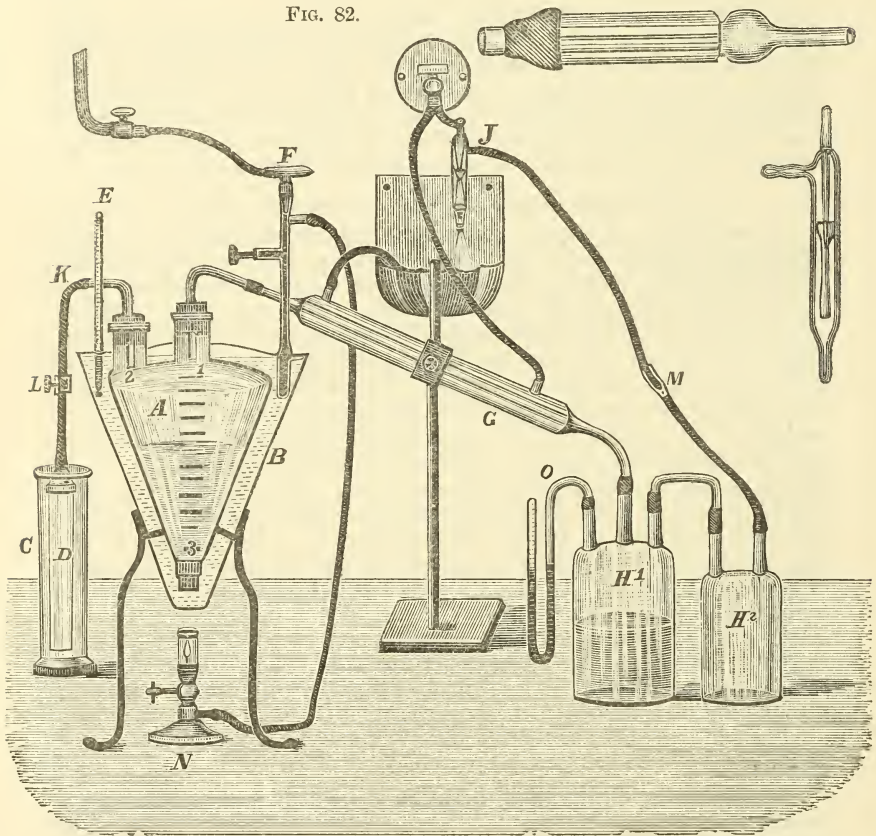
Apparatus for Cultivating Anaerobic Bacteria.†—Prof. M. Ogata describes a simple and easily made apparatus which he has used successfully for the cultivation of anaerobic microbes for some years.

* *Centralbl. f. Bakteriöl. u. Parasitenk.*, xi. (1892) pp. 623–4 (1 fig.).

† *Tom. cit.*, pp. 621–3 (2 figs.).

A test-tube filled in the usual manner with gelatin or agar and plugged with cotton-wool, is drawn out by means of the blow-pipe flame just below the cotton-wool plug, until it becomes longer and narrower than the tube of a Liborius' apparatus. This heating does not affect the gelatin. Then a small glass tube is drawn out into a capillary tube, a few centimetres of the original being left, so that the capillary portion is longer than the test-tube. The latter, after the cotton-wool plug has been replaced, is sterilized by heat. The nutrient medium having been liquefied by immersing the tube in lukewarm water, is inoculated by means of the capillary tube. The wide part of the capillary tube is then connected with the apparatus for developing gas (H , CO^2 , &c.) and its end pushed close down to the bottom of the test-tube. As the gas enters the air is driven out, and when this is effectually completed the capillary tube is withdrawn and the test-tube sealed up at the narrow part.

FIG. 82.



Apparatus for Evaporating Fluids at Low Temperatures.*—Dr. S. v. Dzierzowski and Dr. L. v. Rekowski have devised an apparatus

* Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 685-9 (3 figs.).

for evaporating down nutrient media so as to avoid the danger of exposing the fluid to contamination during the process. The apparatus will evaporate a watery fluid at a temperature of 23° to dryness in quite a short time, and keep it germ-free; it consists of two parts: a conical glass vessel holding 3-4 litres; in the base, which is uppermost, are two openings, and the apex of the cone is also open; all three openings can be closed with caoutchouc plugs. This vessel is placed inside another made of brass and of similar shape. The latter is supported on an iron stand, and is fitted with glass windows for observing the evaporating fluid, a thermometer, and a thermo-regulator. Besides the foregoing are required caoutchouc plugs, bent glass tubes, a Chamberland's filter, Wolff's bottles, with a manometer, a Liebig's cooler, and a water suction pump.

The arrangement of the apparatus is shown in fig. 82, and after all the various parts have been carefully sterilized, the glass vessel A, with its three openings closed, is placed inside the metal case B. Above the opening 3 is a firm rubber valve. The plugs are then removed from 2 and 3, and these apertures connected with D the filter and G the cooler. The other end of G the cooler is in its turn connected with the water pump J through the mediation of the Wolff's bottles H¹H².

The water-tap is now turned, and the pump beginning to act, exhausts the air from the apparatus. The fluid to be filtered is then poured into the filter, and in about seven minutes the first drops begin to fall into A. As soon as the desired quantity is obtained, the process is stopped by the clamp L. The pan B is then filled with water and the burner N underneath lighted. The temperature of the water-bath is to be regulated for 38° . In twenty-four hours about two litres of fluid will have been filtered.

This part over, air is allowed to enter by removing first the Chamberland's filter and replacing it by a glass tube constricted at one place and stuffed with cotton-wool. The screw L is then loosed and air, filtered through the cotton-wool, enters the apparatus.

New Method for Ascertaining the Temperature of Sterilizing Ovens.*—On account of the difficulty of regulating the thermometer M. Quénu uses a small tube filled with an easily fusible mass for indicating the temperature of his sterilizer. Sulphur which melts between 112° and 117° , benzoic acid, and an alloy of bismuth and tin which melts between 130° and 143° were found to answer best. The author states that the method is convenient but costly.

Cold-sterilized Albuminous Nutrient Media.†—Dr. A. Reinsch makes milky nutrient media in the following manner. 500 ccm. of fresh cow's milk mixed with 1.0 gm. of NaHO are well shaken up in a separator-funnel and then allowed to stand for 48 hours at a temperature of about 18° . At the end of this time the fatty matters are collected in a creamy layer on the surface of the fluid, the now pretty clear fluid is transferred to another filter and then shaken up with 250 ccm. of ether. At the end of 48 hours the ether has separated from the clear but slightly opalescent fluid. The latter still contains a considerable

* La Semaine Méd., 1892, p. 203. See Centralbl. f. Bakteriologie u. Parasitenkunde, xii. (1892) p. 40.

† Centralbl. f. Bakteriologie u. Parasitenkunde, xii. (1892) pp. 30-2.

quantity of ether, which is removed by heating the fluid, in flasks plugged with cotton wool, up to 50° and then placing it under an air pump whereby the ether is evaporated in 3-4 hours. This sterile and fat-free milk may be used as a cultivation fluid or rendered solid as follows:—Two parts of this unfatted milk are mixed with one part of a 3-4 per cent. agar solution at a temperature of 50° and then placed in test-tubes. The tubes should then be placed in an incubator for a few days in case any air germs may have infected them. Made in this way milk-agar is quite transparent pale yellow, and with reflected light faintly opalescent.

Dr. R. Wollny* has devised a method whereby many of the inconveniences unavoidable in the customary methods of sterilizing cultivation media are obviated. He has found ordinary ethyl-ether to be an excellent agent for this purpose and the subsequent removal of which does not present the slightest difficulty. Not only does it not affect the chemical composition of the fluids on which it exerts a sterilizing influence, but it also aids in removing from them fatty matters usually so detrimental to cultivation media.

The juice of finely chopped-up meat, fish, liver, potatoes, &c. (or blood, urine, milk), which has been expressed or extracted with water, is mixed with 10 per cent. of ether and placed in a closed vessel. If any acetic acid be present from the oxidation of the ether it must be neutralized with an alkali. The fluids are then cleared by decantation or filtration or may be thickened by the addition of 3 per cent. agar solution or 15-20 per cent. gelatin solution. The ether is then removed by placing the nutrient fluid in a flask closed with cotton-wool; the flask is next heated to 35°-40° and placed under the receiver of an air-pump. The fluid is then ready for use, although at this stage it may be mixed with agar-gelatin or soda solution. None of the albumen is lost and it is perfectly unchanged.

Many nutrient solutions prepared in this way, such as meat, liver, potato, are of a rather dark colour, but they are usually quite transparent enough for cultivation purposes; others, such as extracts of intestine, fish, milk, are perfectly clear and transparent.

In preparing milk by this method it is necessary to use a larger quantity of ether in order to completely remove all the fat, and also to add caustic soda solution if a perfect and transparent solution is desired.

Growth of Bacteria on Acid Nutritive Media.†—The most prevalent notion as to the reaction of cultivation media is, says Herr G. Schlüter, that an alkaline or neutral reaction is almost absolutely necessary. In order to show that an acid reaction is not so very inimical to bacterial growth, the author made a series of experiments with some of the best known bacteria such as *Bac. typhosus*, *Bac. anthracis*, *Staph. pyogenes aureus*, Friedlaender's pneumonia-coccus, the coccus of erysipelas, and others. The basis of the medium was ordinary gelatin or isinglass mixed with 1.25 grm. pepton, 1.25 grm. NaCl, and 250 grm. water. To this mixture were added acids (lactic, tartaric, citric, acetic, hydro-

* Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 752-6.

† Tom. cit., pp. 589-98.

chloric) or alum in various degrees of concentration. The cultivations were made in test-tubes at temperatures varying from 16°–23°.

The results, carefully tabulated and recorded, amount to this, that a large number of bacteria grow on acid media, some indeed very well, provided that a certain degree of acidity be not exceeded. The maximum acidity of the medium was found to vary extremely for each different species. The only Schizomycete which would not grow at all on any acidified medium was the micrococcus of erysipelas, while the *Bacillus anthracis* grew even when the medium contained 0·2 per cent. of lactic acid, and with 0·2 per cent. of alum its growth was better and more rapid than on neutral media. Nor was the virulence of the anthrax diminished, as was proved by inoculation experiments on mice.

It would appear that the biological characteristics of some fission fungi are brought out very clearly on acid media; among these may be mentioned the bacillus of typhoid and the bacillus of blue milk; the latter grown on isinglass decoction, to which 0·2 per cent. of lactic acid had been added, developed its well-known pale blue hue, a phenomenon which does not occur on alkaline substrata.

Pure Cultivation Methods and Specially Koch's Plate Cultivation and the Limit of Error of this Method.*—In the first part of his article Herr J. C. Holm passes in review the history of pure cultivation methods and points out that pure cultivations may serve two different ends, viz. for examining the morphology of a micro-organism and for making physiological experiments with it.

The second part is an experimental study on the limits of error in Koch's plate cultivation method, though in reality it only deals with the problem of how many pure cultivations arising from a single cell can be obtained by isolating yeast cells on gelatin plates, bacteria being left out of consideration altogether.

The third part deals with the numerical variability of yeast cells capable of developing in wort gelatin, according as these cells are taken at the beginning or end of the fermentation process, and also discusses the gelatin media suitable for yeast cells. It is here stated that 4·5 per cent. of the yeast at the beginning and 25·5 per cent. of that at the end of the fermentation process is incapable of development, and that gelatin made up with beer wort gives the best results.

Preparing Catgut.†—Herr Braatz has made some experiments for the purpose of showing how fat prevents disinfection. Pieces of catgut 1–1½ cm. long were sterilized in dry heat of 140° for 3 hours; these were then infected with fresh anthrax spores and preserved dry. He then succeeded in showing that oil had a detrimental effect in disinfecting with sublimate solution.

Hence if catgut is to be effectually disinfected it must be deprived of fat, and this is best done by means of ether, and after this, treatment with sublimate is the best procedure.

The author further made some experiments as to the sterilization

* CR. des Travaux du Laboratoire de Carlsberg, iii. (1891) pp. 1–23. See Centralbl. f. Bakteriologie u. Parasitenkunde, xi. (1892) pp. 576–7.

† Brun's Beiträge zur Chirurgie, vii. (1891) No. 1. See Centralbl. f. Bakteriologie u. Parasitenkunde, xi. (1892) pp. 627–8.

of catgut by means of heat and used for this purpose a Liebig's bath filled with olive oil. Catgut left at 140° for 3-4 hours was found by cultivation and by experiment to be perfectly sterile.

The author recommends two methods for preparing sterilized catgut. (1) Raw catgut rolled round a glass cylinder is unfatted by immersion in ether (ethyl) for 1-2 days. The complete absence of fat is easily ascertained by pouring out a little ether in a watch-glass and allowing it to evaporate; if there be no residue then the fat is completely removed. The ether should be renewed once or twice. From the ether the catgut is removed straight away to sublimate solution 1-1000 wherein it remains for 24 hours, after this it is preserved in absolute alcohol.

(2) Raw catgut having been unfatted as in the foregoing method is rolled in bibulous paper and heated in an oil bath for 4 hours. It is then placed in absolute alcohol.

(2) Preparing Objects.

Simple Method of Substituting Strong Alcohol for a Watery Solution in the Preparation of Specimens.* — Prof. W. A. Haswell suggests the following method:—“Lo Bianco has in the last part of the ‘Mittheilungen aus der Zoologischen Station zu Neapel,’ published an account of the methods which he follows in preparing those marvellous specimens of marine invertebrates for which the station has long been famous all over the world. Many of the methods described have now been known to zoologists for some time, i. e. many of the methods of killing and fixing; it is more perhaps, on account of the information which it gives us, as the result of a long series of trials, as to what reagents are best adapted to each special group, with the best modes of application in each case, than as giving any entirely new formulæ, that the paper is of value.

As is well known, marine animals of different groups require to be dealt with in very different ways in order that we may preserve them in anything approaching to their natural form. Some may be taken by surprise, if we may use the expression, and killed so suddenly by some powerful poison that they remain fixed in a life-like shape. Others must be narcotized or paralysed by some such reagent as chloroform, weak alcohol, or chloral hydrate, before the killing and fixing agent is used.

Whatever be the method of killing and fixing employed, there is in all delicate organisms a difficulty experienced in preventing shrinkage during the later processes which the specimens have to undergo before reaching the strong alcohol stage. In the most admirably fixed specimens shrivelling will often appear when alcohol is applied. This difficulty is partly overcome, with great pains, by using a series of alcohols of ascending degrees of strength. But the result of this mode of procedure is not by any means always satisfactory.

Dr. Cobb, in a paper read before this Society,† has described a method by which, in the case of small organisms, the shrinkage due to change from one fluid to another of a different density may be reduced to a minimum. In his differentiator we have an instrument of

* Proc. Linn. Soc. N. S. Wales, 2nd series, vi. (1891) pp. 433-6.

† Op. cit., v. p. 157. See this Journal, 1890, p. 821.

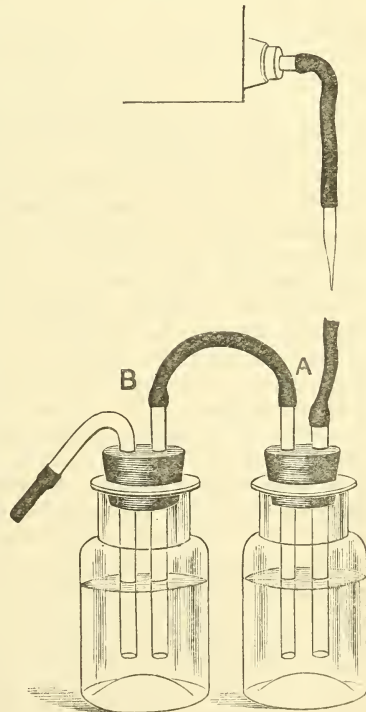
admirable simplicity for insuring this result. But I have found that in practice the use of the differentiator involves a considerable expenditure of time. To get a specimen from distilled water to 90 per cent. alcohol for example, no fewer than eleven different mixtures of water and alcohol have to be made up and poured into the reservoir tube.

A simple piece of apparatus which I have devised does away entirely with this—the gradual substitution for one another of the two fluids of different densities being effected automatically. An obvious mode of meeting the difficulty suggests itself at once. Why not have the second fluid falling into the first drop by drop, mixing thus very gradually with it and eventually replacing it? The difficulty in the way of this is that as each drop of the much lighter liquid enters the denser, violent though circumscribed currents are produced which are damaging to the delicate organisms we are dealing with.

The requisites for the method about to be described are—several reservoirs of glass or earthenware fitted with glass taps and having each a capacity of a gallon or more, some wide-mouthed bottles of a variety of sizes, fitted with perforated india-rubber stoppers, and some lengths of glass and india-rubber tubing.

Two bottles of similar size are connected together by tubing in the way represented in the woodcut. One of these A we call the mixing bottle; the other B contains the objects, and must have a capacity (fig. 83) equal to *at least* a hundred times the bulk of the latter. The objects are in fluid 1, and it is desired to substitute fluid 2. Both bottles are filled, or partially filled, according to circumstances, with fluid 1, and bottle A is connected with a reservoir of fluid 2. It is somewhat difficult by means of a tap to regulate the flow so that, let us say, one drop in five seconds will pass out of the reservoir; and it is much more convenient to effect this by intercalating in the supply pipe a section of glass tubing drawn out to the required degree of fineness (represented in the figure as disconnected from the proximal portion of the supply tube). The rate of flow through this narrow section of the tube can be further regulated by raising or lowering the reservoir or the mixing bottle, thus altering the pressure. With bottle B is connected an overflow tube. Above the narrow section of glass tubing in

FIG. 83.



the supply pipe it is well to have a piece of filter paper stretched across the mouth of the piece of tubing in the form of a diaphragm, and held in place by the overlapping india-rubber tubing. This prevents the possibility of the narrow part of the tube being choked up by any minute particles.

Fluid 2 thus enters into the mixing bottle at an extremely slow rate of flow, and becomes completely diffused, at first in extremely minute quantity, through fluid 1. The fluid from the mixing bottle is meanwhile entering bottle B at the same extremely slow rate, and it is obvious that with two fluids that readily mix, fluid 1 may be made to replace fluid 2 in bottle B with the required excessive slowness and regularity.

In the case of some of the liquids used in fixing and preserving, it is not necessary to use such a precaution as this. We may substitute saturated solution of corrosive sublimate for sea-water without the least risk of damage to the most delicate structures—the specific gravity of the two being very nearly the same.

Similarly distilled water may be at once substituted for osmic acid solution, or 1 per cent. chromic acid, or other fluid that does not differ at all widely from water in specific gravity. But with certain fluids the gradual substitution is necessary, and it is above all necessary in replacing water or a watery solution by alcohol, and this, in the case of large specimens intended for museum purposes as well as smaller objects, can very conveniently be carried out by the simple apparatus I have described above.

Another method of effecting this substitution is the one devised by Schultze; and this seems to possess some decided advantages, at least for small objects. Schultze places the objects which he wishes to transfer from water to alcohol in a tube full of water, plugged at one end, and closed at the other by a diaphragm of chamois skin. The tube is placed in a vessel of alcohol and left there until by a process of diffusion through the diaphragm the water in the tube becomes completely replaced by alcohol, the same material being used for the diaphragm. The time which will be occupied before complete substitution takes place will vary with the capacity of the tube and the diameter of its orifice; and a series of experiments and calculations would have to be made before this method could be used with the assurance of good results. Should it be desired to have the specimens in absolute alcohol at the end of the process, some calcined sulphate of copper may be placed in the outer vessel."

Investigation of Blood of Amphibia.*—Dr. A. B. Macallum experienced great difficulty in finding a reagent which would show the presence not only of hæmoglobin, but of its antecedent, if such existed. Of the dyes belonging to the aromatic group of organic compounds eosin was the only one which was found to be useful. A reagent of great service was the staining fluid of Shakespeare and Noring which the author calls the Indigo-carmine Mixture. As he makes it, it consists of a mixture of equal volumes of two solutions; one consists of carmine 2 grm., borax 8 grm., and distilled water 100 c.c. The other is com-

* Trans. Canadian Institute, ii. (1892) pp. 222-8.

posed of indigo-carmin 8 grm., borax 8 grm., and distilled water 100 ccm. The section to be stained is left in the fluid for 15 minutes, then plunged in a saturated solution of oxalic acid for 10 minutes, washed in distilled water, dehydrated with absolute alcohol, cleared in pure xylol, and mounted in benzole balsam. Essential oils should be avoided as they appear to oxidise the indigo-carmin, and cause the stain to fade.

For the hardening of the tissues preparatory to cutting, small portions should be half an hour in a saturated solution of carmin sublimate, or 5 days in Erlicki's fluid, or 24 hours in a 1/5 to 1/3 per cent. solution of chromic acid, 5 hours in a saturated solution of picric acid, or 2 to 5 hours in 1 per cent. solution of osmic acid. They must then be washed in distilled water, and put in 50 per cent. alcohol for 2 hours, in 70 per cent. for 24 hours, and finally in 95 per cent. The pieces may be imbedded in mucilage and sectioned in the freezing microtome, or by the chloroform method in paraffin. The great value of these preparations lies in the fact that hæmoglobin is stained grass-green or greenish-blue, while other proteid elements are coloured red, save a few about which there can be no mistake.

Alum-hæmatoxylin, in which ammonia-alum is dissolved to saturation, and Czokor's alum-cochineal were also of great value in the study of the hæmatoblasts of the larvæ of *Amblystoma*.

Cover-glass preparations of blood were fixed either in the fumes of osmic acid (1 per cent. for 2 hours), or by a saturated solution of corrosive sublimate or picric acid, or by Erlicki's fluid. The fixation was completed as usual with alcohol, and the various dyes already mentioned were used for staining the preparations.

Examination of Teleostean Ova.*—In his study of the mesoderm of Teleostean fishes Mr. E. R. Boyer made use of the oviparous Cyprinodont *Fundulus heteroclitus*. The ova were killed at intervals increasing from one hour in the younger to eight hours in the older stages. The killing reagents used were Perenyi's fluid, Kleinenberg's picro-sulphuric mixture, and a solution of 0.25 per cent. osmic acid, followed by Whitman's modification of Merkel's fluid. The ova were next carried through grades of alcohol to 90 per cent. Those preserved with Perenyi's fluid proved to be most satisfactory in the earlier, and those with Kleinenberg's mixture in the later stages. The best staining results were obtained by the use of Kleinenberg's hæmatoxylin *in toto* for 20 to 24 hours, and decolorizing with 70 per cent. acidulated alcohol for about 2 to 4 hours. With osmic material, however, the best results were attained by the use of Czokor's cochineal for 10 to 12 hours. The embryos were removed from the yolk under the dissecting Microscope, dehydrated, penetrated with clove or cedar oil, followed with paraffin at a temperature of 55° C., imbedded in paraffin in the usual way and cut into sections by a Thoma or a Cambridge rocking microtome.

Study of Germinal Layers of Petromyzon.†—Mr. S. Hatta hardened the eggs and larvæ of *Petromyzon* partly in Kleinenberg's picro-sul-

* Bull. Mus. Comp. Zool., xxiii. (1892) pp. 93 and 4 (8 pls.).

† Journal Coll. Sci. Imp. Univ. Japan, v. (1892) p. 130.

phuric acid, and partly in corrosive sublimate. A few larvæ were also killed in Flemming's solution. The sublimate specimens gave the best results. Picrocarmine was found to be the best staining reagent, as, being a nuclear stain and not affecting the yolk-granules, it made observation comparatively easy.

Preparing Liver of Gastropoda and the Reconstruction of Organs.*—For his observations on the morphology of the liver of Gastropoda, Dr. H. Fischer made use of sections of embryos; these were imbedded in paraffin and previously fixed with saturated aqueous solution of sublimate, with alcohol or with picrosulphuric acid. This method, though not altogether irreproachable from a histological standpoint, is quite satisfactory for morphological purposes, as it not only allows of thin sections being made, but of the object being reconstructed from them. In reconstructing an object it will be found very useful to draw with the camera the outlines of the embryo after it has been fixed, as the possession of this contour renders it easier to reconstruct the object from drawings of its sections.

The usual method of reconstructing a model of the object in relief is to make copies of the different sections in wax. Each wax plate should have a thickness equal to the product of the thickness of the section of the enlargement of the drawing. The outline of the object of each section is then drawn on these plates with the camera, and then the superfluous parts cut away. The plates having been joined together, an enlarged model of the original object is obtained.

It is very important that the sections should be kept in series, or that some method for finding out the proper position of the individual plates should be adopted. If there be no possibility of doing this from the shape of the object or of its component parts, then marks must be placed on the surface of the paraffin block. These marks may be made by scratching a shallow furrow on one or more faces of the block, or by including a hair. The former is better, as some colour, e. g. black lead, may be worked in.

When the organs are very thin or of very irregular shape, wax models are too fragile, but the difficulty may be avoided by cutting out the organs to be represented from the plate, so that the organ is represented by a cavity, and this may be reproduced, after the model is finished, by means of a plaster cast.

Investigation of Nephridia of Prosobranchs.†—Dr. R. v. Erlanger dropped living specimens of *Patella* and *Fissurella* into Kleinenberg's picro-sulphuric fluid with a few drops of osmic acid, or into a mixture of sublimate 5 per cent. in sea-water 3 parts and 1 part of glacial acetic acid. Flemming's chromosmic acetic fluid was found to make the tissues too brittle. In *Trochus* it was necessary to use a different method, on account of the stout shell and operculum. The specimens were, therefore, put into sea-water and 1 per cent. absolute alcohol in order to draw the anterior half of the body out of the shell. After a day or two the animals are paralysed without being killed. The fixing

* Bulletin Scientifique de la France et de la Belgique (Extr. from), xxiv. (1892) 87 pp. (7 pls.).

† Quart. Journ. Micr. Sci., xxxiii. (1892) pp. 589-91.

liquid will now easily penetrate the shell and the mantle cavity. The chief stain used was alum-carmine, used to stain in bulk. It is convenient to remove the foot and other organs with a razor or a pair of scissors, as a great deal of time and trouble may be saved, and the stains penetrate more easily. The sections were cut with Yung's microtome, after imbedding in chloroform and paraffin. At Prof. Lankester's suggestion use was also made of the injection method, though the author is strongly prejudiced against it, as he thinks it very likely to mislead. He used soluble Berlin blue, and injected by blowing the injection through a fine glass pipette with the mouth; these injections confirmed the results obtained by dissections and sections. But the use of syringe and strong pressure resulted in the breaking of the walls at various points.

Preparation of Nudibranchs.*—Most of the Nudibranchs whose cerata have been studied by Prof. W. A. Herdman and Mr. J. A. Clubb were killed and fixed with Kleinenberg's picric acid, stained with picro-carmine, passed through graduated alcohols, imbedded in paraffin, and cut with the Cambridge rocking microtome. The specimens of *Hermæa dendritica* were obtained at Plymouth by Mr. Garstang, who plunged them for a moment, while alive, into glacial acetic acid, transferred them to a saturated solution of corrosive sublimate for half an hour or so, and then passed them through grades of alcohol.

Study of Development of *Limulus longispina*.†—Mr. Kamakichi Kishinouye fixed the eggs of *L. longispina* by heating in water to 60° or 70° C., or by plunging into water of that temperature. After cooling they were transferred to 70 per cent. alcohol, where they were left for one or two days. Eggs in early stages were in some cases pierced through into the yolk with the point of a fine needle at two or three points, care being taken not to hurt the germinal disc. These perforated eggs were left in 70 per cent. alcohol for one or two days more, and were afterwards dehydrated in increasing grades of alcohol. For the surface view of the embryo the ventral plate was peeled off the underlying yolk of the preserved egg, and was stained by borax-carmine, washed in acidulated alcohol, and imbedded in Canada balsam, after dehydration and clarification.

Eggs which it was proposed to cut into sections were stained with borax-carmine or hæmatoxylin *in toto*; owing to the abundance of the yolk the process of section-cutting was very troublesome. Very good sections were obtained by the use of the celloidin-paraffin method.

Investigation of *Nectonema*.‡—Mr. H. B. Ward found that the resistant cuticle of this worm, which hinders the passage of most fluids, and its strong tendency to curl in the killing fluid were great obstacles in the successful preservation or sectionizing of specimens. The best reagents were found to be a saturated aqueous solution of corrosive sublimate and Perenyi's fluid heated to about 60°. Picro-nitric acid gave nearly as good results. The curling of the specimens may be largely prevented by straightening the worm gently with the fingers,

* Quart. Journ. Micr. Sci., xxxiii. (1892) p. 544.

† Journal Coll. Sci. Imp. Univ. Japan, v. (1892) pp. 56 and 7.

‡ Bull. Mus. Comp. Zool., xxiii. (1892) pp. 136 and 7.

and dropping it suddenly into the warm killing reagent. Eight carmine solutions were tried, but the only one which was useful for staining was Mayer's hydrochloric acid carmine, after prolonged immersion. All hæmatoxylin solutions stain well, but require more time than usual.

In imbedding in paraffin it is necessary to keep the temperature low. Series cut in paraffin of 50°-52° were in all respects most successful. The infiltration must be complete, but a long immersion in paraffin renders the objects very brittle. Maceration was tried on preserved material with little success. Great assistance was derived from the study of portions of the body which had been cleared in clove-oil before staining.

Examination of Lucernariidæ.*—Dr. G. Antipa found picrocarmine and Beale's carmine the best staining reagents, but good results were obtained with osmic acid and gold chloride; for the last Löwit's or Viallanes' methods may be used. For the study of the separate epithelial cells macerations were chiefly effected by Hertwig's mixture of 0.05 per cent. osmic acid 1 part, and 0.2 per cent. acetic acid 2 parts.

Method of Examining Blood, Bone-Marrow, and Body Juices.†—Dr. R. Muir makes blood films on cover-glasses, and then before the film can dry it is placed face downwards on the surface of a saturated solution of sublimate with 3/4 per cent. of sodium chloride added, for about half an hour. If the solution be heated to 50° C. it acts better. The cover-glass is next washed in 3/4 per cent. salt solution, and then passed through successive strengths of alcohol. After this it may be stained in the usual manner and with the staining solutions used for sections.

Bone-marrow is lightly dabbed on the cover-glass, not spread, so as to form a thin layer, and then treated as above.

New Method of Preparing Dentine.‡—Dr. W. Lepkowski finds that the following modification of Ranvier's fluid serves excellently well for simultaneously softening and staining dentine and also bone.

In a mixture composed of 6 parts of a 1 per cent. watery solution of gold chloride and 3 parts pure formic acid are placed pieces of teeth 1/2 - 3/4 mm. thick.

The little bits of teeth, obtained by means of a hand-saw, have, after an immersion in the foregoing fluid for 24 hours, the consistence of cork, and can be easily cut with a razor. When removed from the solution the pieces of teeth are first washed with distilled water, and then placed in a mixture of gum arabic and glycerin for 24 hours. On removal from this last reagent, the pieces are again washed with distilled water and then with alcohol, after which they may be imbedded in celloidin or paraffin and sectioned.

This procedure is much better adapted for fresh teeth than for those which have been kept for any length of time.

The method is also applicable to bone, thin slices of which are decalcified within 24 hours.

Preparation of Vegetable Tissues.§—Mr. A. Flatters gives detailed instructions in the use of the microtome and the cutting of sections

* Zool. JB., vi. (1892) p. 379. † Journ. Anat. and Physiol., xxvi. (1892) p. 393.

‡ Anat. Anzeig., vii. (1892) pp. 274-82 (1 pl.).

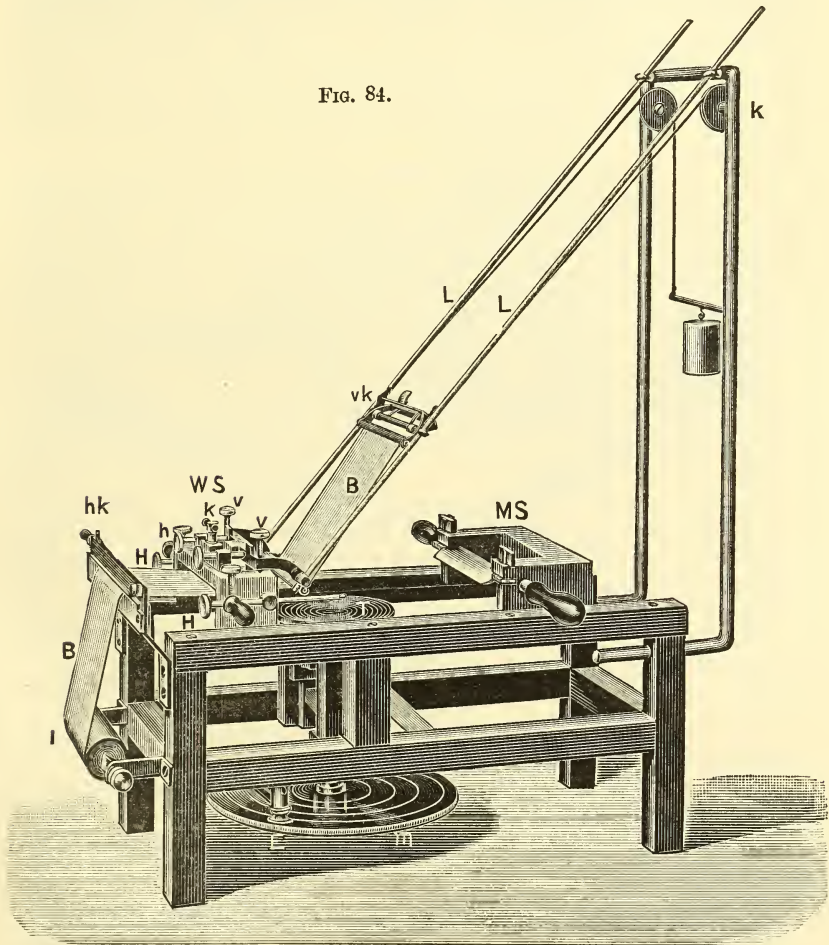
§ Trans. Manchester Micr. Soc., 1891, pp. 38-47 (1 pl.).

of vegetable tissues, the preparation of leaf- and flower-buds, the mounting of celloidinized sections, and the staining of vegetable tissues with logwood, and with borax-carminé and iodine-green. Formulæ are given for preparing Kleinenberg's hæmatoxylin, picrocarminé, borax-carminé, and glycerin-jelly.

(3) Cutting, including Imbedding and Microtomes.

Strasser's Ribbon Microtome.*—Prof. H. Strasser describes a larger model of his so-called "Schnitt-Aufklebe" Microtome.†

FIG. 84.



The details of the instrument are seen in fig. 84. The knife-holder MS runs on a double slide-way, and the object-carrier T is raised

* Zeitschr. f. Wiss. Mikr., ix. (1892) pp. 1-13. † See this Journal, 1891, p. 281.

by the micrometer screw M. There is a catch arrangement at E for determining the thickness of the sections.

The arrangement of the paper band, to the under surface of which the sections are made to adhere, is similar to that previously described. From the roller I the band passes through the guiding loop *h* K, thence through the apparatus for smearing the paper, and on to the knife-edge where it is directed upwards to the clamp *v* K, to which are attached two strings passing over the pulleys *r* and kept taut by a weight.

The apparatus for smearing the paper consists of a box containing three rollers. Roller III, in front, which is of metal and of small diameter, serves to keep the paper band in the plane of the knife-edge. The two hinder rollers are of wood covered with felt. Roller II, is set in motion by the advancing paper band and transmits the motion to roller I; the latter takes the adhesive material and conveys part of it to roller II, which spreads it uniformly on the under surface of the paper band.

The roller-holder WS and knife-holder MS are similar in construction. In both two side pieces engage underneath in the horizontal slide-way, and are connected above by a strong cross-bar. The two vertical screws *v* on the end of the cross-piece of the roller-holder serve to adjust the rollers in height, while the two horizontal screws *h* allow one or other side of the roller to be pushed forward. Finally the two horizontal screws H regulate the distance of the rollers from the knife-holder.

The great advantage which the author claims for this microtome is that it can be used especially for relatively soft material. The present instrument allows of a raising of the object-stage 6 cm., so that objects 10 cm. broad, 15 cm. long, and 6 cm. thick, can be cut from beginning to end.

As regards the after treatment of the sections on the paper band, the author has made several improvements on the methods previously employed. In the first place there is no necessity to cover the sections with adhesive mixture before placing them in the benzene bath. It is sufficient to lay the plates carefully between canvas.

The whole series of operations in the use of this microtome are summarized as follows:—

A. Cutting and banding the sections on gummed paper. Numbering.

B. Covering the paraffin layer with a coat of celloidin, a process which involves

1. Placing the plates horizontally between canvas in a benzene-turpentine bath. Several hours.

2. Evaporating and drying.

3. Placing in 95 per cent. alcohol between canvas. 12 hours.

4. Evaporating and drying.

5. Collodionizing by immersing twice in thick collodion.

6. Keeping provisionally in 80 per cent. alcohol or glycerin-alcohol.

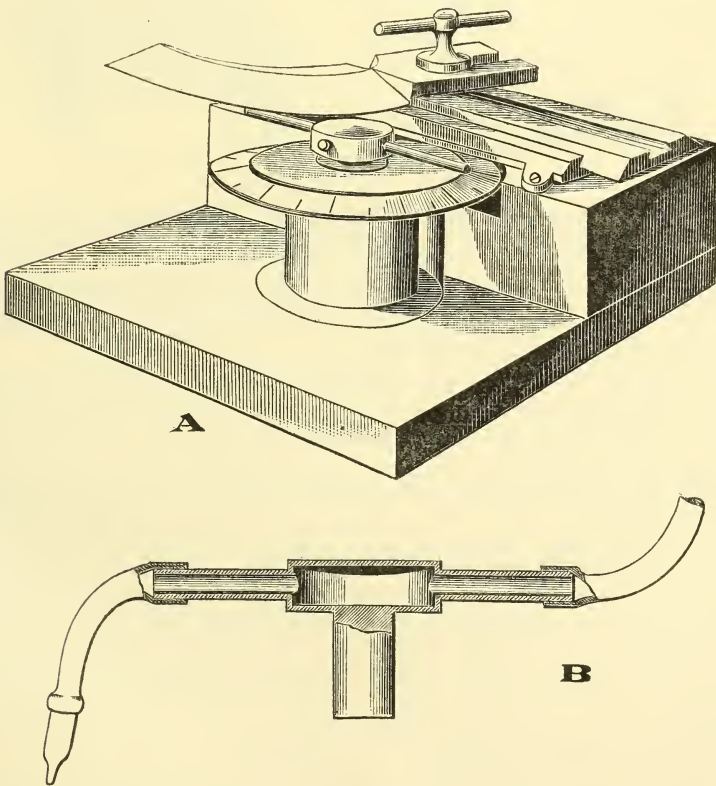
C. Staining after removing the paper beneath the sections by immersing in water.

D. Clearing, &c.

1. Placing in weak alcohol between canvas, and afterwards,
 2. With fresh paper beneath, and after drying, in strong alcohol.
 3. Immersing in a bath composed of three parts of oil of turpentine and one of creosote, and then in liquid paraffin.
 4. Covering with a second layer of paper and arranging in series.
- According to the author's experience by far the most satisfactory adhesive material for sticking the sections on the paper-band is a thick solution of gum arabic.

Freezing Microtome.—We append a figure of Dr. T. Taylor's microtome, a description of which has already appeared.* Fig. B shows a sectional view.

FIG. 85.



New Cup for Sections.†—Dr. Eternod, in view of the inconveniences of the ordinary porcelain cups used for collecting series of sections of embryos, has had recourse to the new processes of manufacture adopted by the firm of Leybold in Cologne, by which glass vessels are made by

* See *ante*, p. 565.

† *Zeitschr. f. Wiss. Mikr.*, ix. (1892) pp. 13-4.

soldering the pieces together by a special cement. The new cup (figs. 86, 87, and 88) made by this firm consists of a very thick glass plate *g*, ground on one face and pierced with a number of holes (fig. 87, *b* and fig. 88, *k*). A sheet of thinner glass *i*, soldered to the thick plate by cement (fig. 88, *h*) forms the bottom of the box and converts the holes

FIG. 86.



FIG. 87.

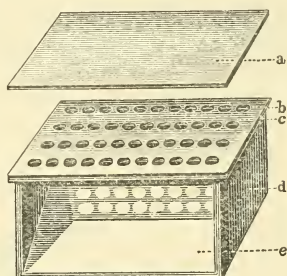
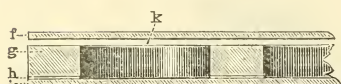


FIG. 88.



in the thick plate into a series of cups; while a third piece of ground glass, fitting accurately on the ground surface of the thick plate, forms the cover.

The apparatus can be placed on a small box *d*, provided with an inclined mirror *e*, which illuminates the cups from below so that their contents can be readily recognized.

To remove Oil and Grease from Whetstones.*—The process consists in stirring up whitening with water and applying it with a brush to the whetstone which has been warmed in an oven.

Oil of Anise-seed as an Imbedding Medium for the Freezing Microtome.†—Dr. H. Kühne has discovered that oil of anise-seed may very successfully be used as an imbedding medium for cutting sections with the freezing microtome. The procedure is as follows:—Pieces about 2 mm. thick are placed on blotting-paper to remove the alcohol, and then immersed in a capsule containing the anise-seed oil for 12–24 hours. When thoroughly saturated with the oil—and this is easily recognized by the clearing up of the material—the pieces are placed on the microtome and sectioned. The sections are temporarily transferred to anise oil on a glass rod, and when all the piece is sectioned, are placed in alcohol (twice repeated) to remove the oil. When all the oil is removed, the sections are ready for staining.

Method of Cold-imbedding in Gelatin.‡—M. C. Brunotti gives the following formula which he has used for some time with very good results and has found very useful for histological purposes. In 200 grm. of distilled water are dissolved by aid of heat 20 grm. of the

* Zeitschr. f. Wiss. Mikr., ix. (1892) p. 135.

† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 28–30.

‡ Journ. de Bot., vi. (1892) pp. 194–5.

white commercial gelatin sold in thin flakes. After filtering through fine cloth about 30–40 ccm. of glacial acetic acid and a gramme of perchloride of mercury are added.

The object of these additions is to keep the gelatin liquid and also to preserve it. At the ordinary temperature, 15°, it has the consistence of thick syrup. According to the season and the temperature it is easy to modify these proportions.

The object to be sectioned is placed first of all in this gelatinous solution diluted with twice or thrice its volume of pure water. It is afterwards immersed in the thick gelatin solution, a little of which has been poured into a paper box. The mass is then set by placing the paper box and its contents in a crystallizer and then carefully pouring round it some spirit. If alcohol should be unsuitable other hardening agents such as picric acid, bichromate of potash, &c., may be substituted, but these reagents act more slowly than spirit.

When sufficiently firm the mass may be sectioned in the usual way and the sections mounted in gelatin or glycerin, or be freed from the gelatin imbedding by dissolving it in water.

(4) Staining and Injecting.

Methylen-blue Staining of Nervous System of Invertebrata.*—Herr O. Bürger, when investigating the nervous system of Nemertine worms, seems to have obtained very good results, judging at least from the coloured illustrations said to be faithful representations, by injecting these animals with a fluid made by dissolving 0.5 gm. methylen-blue in 100 gm. of 1/2 per cent. cooking salt solution, or with a simple watery solution of the same strength. Sea water, in which methylen-blue is imperfectly soluble, is quite unsuitable for the purpose. The injections were made frequently, one injection imparting only a faint staining. The best period for injecting was in the half-dead condition, or in that state when the animal or parts thereof still show signs of life. The time required for bringing about good injection results was at least 6–8 hours, and sometimes much longer. After a time the author found that satisfactory results were more easily obtained by merely injecting a part or organ. The preparations were fixed with dilute picrate of ammonia, and afterwards put up in glycerin to which a trace of ammonia had been added.

The staining does not last very long, and hence in examining a specimen it is advisable to begin at those parts from which the blue colour first disappears, viz. at the periphery.

Permanent Preparations by Golgi's Method.†—Dr. G. C. Huber finds that permanent preparations of nervous tissue stained by Golgi's method can be obtained in the following manner:—The pieces are to be hardened and silvered according to the procedure advised by Ramon y Cajal and von Kölliker, and celloidin sections cut up under 95 per cent. spirit. The sections are then immersed for 15 minutes in creosote and then transferred for some minutes to turpentine. After this they are

* Mittheil. Zoologisch. Station zu Neapel, x. (1891) pp. 206–54 (2 p's.).

† Anat. Anzeig., vii. (1892) pp. 587–9.

spread out on a slide, and having been mopped up with blotting-paper, are covered with turpentine balsam. The slide is then gradually and very carefully heated over a flame until the balsam has become so inspissated that it sets hard when cooled. At this stage the cover-glass is put on the hot balsam. The heating takes from 3-5 minutes.

Staining Fibrin.*—M. Sabouraud communicates a method for staining fibrin which is said to be superior to that of Weigert. Pieces of chancre fixed in Müller's fluid are placed for 15-20 hours in the following solution:—Tannin 1-200, alcohol 10 ccm. to 200 of the solution; they are then stained with anilin-violet (Ehrlich) and then coloured by the Gram-Weigert method, in which during decoloration clove oil is substituted for anilin oil.

Some Facts about Lustgarten's Method for Staining Syphilis Bacilli.†—M. Sabouraud, after having frequently failed to find bacteria in syphilitic products by Lustgarten's method, lighted on a case of ulcerating gumma, in the pus of which he succeeded in demonstrating by Lustgarten's method some bacilli. These bacilli were not stained by Ehrlich's method. The author therefore presumed that he had found the bacilli of syphilis. But a guinea-pig having been inoculated with this pus, died of tuberculosis.

The author then raises the question whether Lustgarten, who did not make any inoculations on guinea-pigs, may not have been mistaken in the true character of the growths. Indeed, it was found that Lustgarten's method was extremely useful for demonstrating tubercle bacilli, especially in the liver.

The author gives a new method for preparing sulphurous acid solution.

New Method for Finding Tubercle Bacilli in Sputum.‡—Herr Dahmen has devised a modification of Biedert's method, the principle of which consists in separating the solid from the liquid portion of the sputum by boiling with caustic soda.

The author states that the same result may be arrived at by heating the sputum for 15 minutes in a vapour bath. The solid particles almost immediately fall to the bottom and, after the liquid portion has been poured off, are well mixed up in a mortar and are ready for examination.

Malachite-green as an Extracting Pigment.§—Malachite-green, says Dr. H. Kühne, when dissolved in anilin oil has the power of extracting fuchsin, methylen-blue, and crystal violet from sections, and specimens of bacteria prepared in this way are excellent for demonstration purposes on account of their sharp differentiation.

For staining tubercle bacilli the method is as follows:—The sections are stained in cold phenol fuchsin for 15 minutes; they are then washed in water and alcohol and afterwards transferred to a saturated solution

* Annales Inst. Pasteur, 1892, p. 184. See Centralbl. f. Bakteriologie u. Parasitenk., xi. (1892) p. 807.

† Annales Inst. Pasteur, 1892, p. 184. See Centralbl. f. Bakteriologie u. Parasitenk., xi. (1892) p. 807.

‡ München. Med. Wochenschr., 1891, No. 38. See Centralbl. f. Bakteriologie u. Parasitenk., xii. (1892) pp. 41-2.

§ Centralbl. f. Bakteriologie u. Parasitenk., xi. (1892) pp. 756-8.

of malachite-green in anilin oil. Very thin sections are decolorized in 2-3 minutes; thicker ones require a correspondingly longer time. The sections are then placed in turpentine for a short time (they should be of a delicate blue-green hue) and then in xylol to remove the turpentine, after this they are ready to be mounted in balsam.

Staining of other bacteria by the malachite-green method is done as follows:—(1) Stain sections in phenol fuchsin for 5 minutes. (2) Wash in water and then just immerse in spirit. (3) Remove to pure anilin oil until quite cleared up. (4) Wash out the anilin oil in turpentine (about 1 minute). (5) Transfer to more or less strong malachite-green anilin oil for 10 minutes or longer, according to thickness of section. (6) Immerse the section in turpentine, xylol, balsam.

It may be mentioned that when sections are placed in turpentine they become covered with precipitated pigment. This soon disappears, and if the sections be left in too long the malachite-green is completely extracted. It is, however, impossible to give an approximate notion of the time required for treating with turpentine. If, however, the green be too much extracted, the sections may of course be returned to the malachite-oil.

The staining of the bacteria is said to be quite undisturbed by this treatment.

Double and Metallic Stains.*—Prof. A. B. Aubert has prepared the following useful compilation.

Bismarck Brown and Methyl-Green.—Bismarck brown, a concentrated warm aqueous solution, or a weak alcoholic solution. Methyl-green, 0·5; water, 100. Sections to be kept in about 15 minutes; wash with water, stain dark green, wash, soaking in alcohol until grass-green; clear in oil of bergamot, xylol; mount in balsam.

Borax-Carmine and Indigo-Carmine.—1. Carmine, 2 grm.; borax, 8 grm.; water, 130 grm. 2. Indigo-carmine, 8 grm.; borax, 8 grm.; water, 130 grm. Mix 1 vol. of 1 and 2. Sections are taken from alcohol and stained in from 15 to 20 minutes; transfer from 15 to 20 minutes to concentrated solution of oxalic acid; wash; dehydrate; mount in balsam.

Eosin and Methyl-Green.—I. Eosin, 1 part; methyl-green, 60 parts; alcohol, 30 per cent.; warm. II. A. Eosin, 1 part; water, 50; alcohol, 50. B. Methyl-green, 1; water, 100. Sections stain in I. in 5 or 10 minutes; quickly wash in successive alcohols, mount in balsam or glycerin. II. is for blood-corpuscles; dry the blood (thin layer) on the slide; treat with A 3 or 4 minutes, wash stain off with water; treat with B 2 or 3 minutes, wash, dry, mount in balsam (red corpuscles red, nuclei and leucocytes bluish-green).

Fuchsin and Methylin-Blue.—A. Fuchsin solution in alcohol, 8 to 10 drops; water, a watchglass-ful. B. Concentrated aqueous solution of methylin-blue. Tissues to be hardened in chromic acid, &c.; stained in A for several to 24 hours; washed with alcohol, stained in B for 4 to 5 minutes (nuclei red, tissues blue).

Hæmatoxylin and Eosin.—Solution of eosin in glycerin in which some salt has been dissolved; concentrated solution of alum in glycerin

* The Microscope, xii. (1892) pp. 152 and 3.

and glycerin hæmatoxylin. Stained specimens washed in alcohol containing a little eosin; clear in oil of cloves; mount in balsam.

Picrocarmine.—I. Carmine, 1 gm.; liquor ammoniæ, 4 ccm.; mix and add 5 gm. picric acid. II. Carmine, 15 gm.; picric acid, concentrated solution. Agitate the mixture (I.) from time to time for 2 days; let it settle; decant and evaporate decanted liquid at ordinary temperature; redissolve the dry residue in water, making 1 per cent. or 2 per cent. solution; filter when necessary.

II. Triturate the carmine in a mortar until very fine; add enough ammonia to dissolve the carmine; to this add slowly concentrated solution of picric acid until the mixture has a blood-red colour; keep in a shallow dish until all odour of ammonia has disappeared; filter; keep in a well-stoppered bottle; add a few drops of carbolic acid; filter before using.

Picrocarmine and Eosin.—Solution of picric carmine, 1 per cent., 1 part; watery solution of eosin, 2 per cent., 1 part. For small organisms, 1/2 to 4 days; wash in 70 per cent., then in 90 per cent. alcohol.

Metallic Stains:—

Ammoniæcal Nitrate of Silver.—Silver nitrate, 0.75 to 0.5 per cent. with ammonia. Add to nitrate of silver solution enough ammonia to redissolve the precipitate which forms at first; dilute to 0.75 per cent. or 0.5 per cent.

Gold Chloride.—A. Gold chloride, 1 gm.; water, 2000 ccm.; hydrochloric acid, 30 drops. B. Alcohol, 1 part; formic acid, 1 part. Sections treated with A, then transferred to B, where reduction of the gold takes place.

Potassium Gold Chloride.—A. Potassium gold chloride, 1 part; water, 10,000 parts; hydrochloric acid, a trace. B. Water, 2 to 3000 parts; hydrochloric acid, 1 part. C. Alcohol, 60 per cent., 1000 parts; hydrochloric acid, 1 part. Sections hardened in ammonium bichromate are put in A for from 10 to 12 hours, until they are of a light violet colour, washed in B, and transferred to C.

Osmic Acid and Silver Nitrate.—A. Potassium bichromate, 2 per cent., 10 parts; osmic acid, 1 per cent., 1 part. B. Silver nitrate, 1 part; water, 200 parts. Objects soaked in A for several hours, transferred to B for at least 8 hours.

Silver Nitrate.—A. Silver nitrate, 0.25 to 0.5 parts; water, 100 parts. B. Salt, 0.75 parts; water, 100 parts. Sections 20 to 40 seconds in A, then in B; move them about in both, then expose to the light.

Silver Nitrate and Silver Iodide.—A. Silver nitrate, 1 part; water, 100 parts. B. Silver iodide, 1 part; water, 100 parts; potassium iodide, a trace. C. Silver nitrate, 0.1 part; water, 100 parts. Put the sections in A (in the dark); after 2 or 3 minutes add a few drops of B; wash the sections in water and expose for 2 days in C to the action of the light (cornea.)

(6) Miscellaneous.

Wethered's Medical Microscopy.*—This little work, one of the numerous guides for the much-written-for medical student, is a good example of the compilations so frequently seen of late years. Its chief distinction is its title, which is inviting and alliterative. In the letter-press there is nothing particularly new except, perhaps, some spelling variations such as Schyzomycetes, Leucaemia, Jolgi; but one original statement deserves a passing notice: the diameter of amyloid casts varies from almost one inch to not more than that of a red corpuscle. This is quite new. Casts of this larger size would not probably require the aid of a Microscope for their discovery, and might be fished up with a walking-stick. The work is apparently quite a compilation.

Reactions of Callus and Paracallus.†—Mr. S. Le M. Moore gives the following microchemical reactions for true callus, and for the proteid substance which he distinguishes from it, under the name of paracallus.

Callus rapidly dissolves on warming sections in Millon's fluid, and displays no tendency to become red. It is soluble in boiling nitric acid; hence the xanthoproteic test does not succeed. On running in caustic potash after sections have lain some time in copper sulphate, callus swells up, but does not turn blue or pink. After a good soaking in syrup, sulphuric acid swells callus so that it is almost invisible but it never assumes the slightest tint of pink. After many experiments with a peptic fluid, allowed to act as long as 86 hours, callus undergoes not the least change in form or general appearance; and it now reacts quite normally with picric blue and corallin soda. The same result followed every attempt to dissolve callus in a pancreatic fluid (Fairchild's pancreatic extract).

Paracallus, on the other hand, stains yellow with picric blue; takes a temporary pink with corallin soda; does not swell up appreciably in sulphuric acid or caustic potash: is stained brown by iodide; is not acted on by carmine; and gives good proteid reactions. It frequently dissolves in a peptic as well as in a pancreatic fluid.

* London, 1892, crown 8vo, 412 pp., with illustrations.

† Journ. Linn. Soc. (Bot.), xxix. (1892) p. 232. Cf. *suprà*, p. 630.

PROCEEDINGS OF THE SOCIETY.

The Conversazione was held at 20, Hanover Square, on Monday, the 30th November, 1891.

The following objects, &c., were exhibited:—

Mr. F. W. Andrew:—*Megalotrocha albo-flavicans*.

Rev. G. Bailey:—Foraminifera from the London Clay.

Messrs. R. and J. Beck:—*Amphipleura pellucida*. *Arachnodiscus Ehrenbergi*. *Polycystinæ* from Barbadoes.

Mr. E. T. Browne:—Foraminifera from the Chalk Rock.

Mr. F. Chapman:—New Hyaline Foraminifera from the Folkestone Gault: viz. *Vitriweblina Sollasi* sp. n., *V. lævis* Sollas, *Poly-morphina Orbignii* var. *cervicornis* var. nov.

Messrs. C. Lees Curties and E. M. Nelson:—Projection Microscope Exhibition.

Monochromatic Light Apparatus.

Mr. E. Dadswell:—Thickened node of *Nitella translucens*.

Mr. J. E. Ingpen:—*Volvox* and *Batrachospermum* preserved in saturated solution of common salt; one year in bottle.

Diatom Structure in Medium:—Bromide of Antimony, Bromide of Arsenic, 1 part each, and Piperine, 2 parts.

Messrs. W. Johnson & Sons:—Anthrax in Lung.

Filaria sanguinis hominis (Diurnal and Nocturnal).

Students' Microscopes with new Substage Adjustment.

Mr. R. Macer:—*Argulus foliaceus*. *Epistylis flavicans*. *Lophopus crystallinus*.

Mr. G. E. Mainland:—Transverse Section of Fertile Head of *Equisetum arvense*: Spores and Elaters *in situ*.

Longitudinal Section of *Pilia grandiflora*: Reticulate and Pitted Cells.

Mr. A. D. Michael:—*Hoplophora carinata* v. *pulcherrima*, a South European Mite.

Mr. J. H. Mummery:—Photographs and Drawings illustrating the Absorption of the Tubercle and other Bacilli by Leucocytes. Photographs of Micro-organisms in Dental Caries.

Mr. E. M. Nelson:—*Navicula firma*, showing a spiral tube at the end of the raphe. Under an Oil-immersion $\frac{1}{12}$.

Mr. C. J. Pound:—Phagocyte enclosing Tubercle Bacilli.

Effusion from Dorsal Lymph-sac of the Frog.

Messrs. Powell and Lealand:—Cherryfield Rhomboides in Balsam with a new $\frac{1}{12}$ in. Apochromatic Homogeneous Immersion 1.4 N.A.

Mr. C. Rousselet:—A Collection of Rotifers.

Mr. G. Smith:—Micro-Transparencies and Rock Sections.

Mr. W. T. Suffolk:—Starch from Potato Fruit. $\frac{1}{4}$ in. with Polariscope.

Mr. J. J. Vezey:—Section of Passion Flower.

Messrs. W. Watson & Sons:—Pacinian Corpuscles in Mesentery of Cat. *Bacillus mallei*, Glanders.

Life-history of Blight of Grape-vine, Phylloxera.

Chlorophyll in Leaf of Moss, *Mnium*.

Group of Diatomaceæ from Glingore, Jutland.

Pleurosigma Genus Slide, 100 Species.

The Microscope Lamps were kindly lent by Mr. G. J. Smith.

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JOURNAL
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ROYAL
MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

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FELLOWS OF THE SOCIETY.



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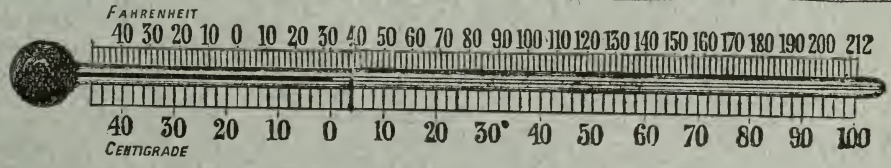
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APERTURE TABLE.

Numerical Aperture. ($n \sin u = a$.)	Corresponding Angle (2 u) for			Limit of Resolving Power, in Lines to an Inch.			Illuminating Power. (a^2 .)	Penetrating Power. ($\frac{1}{a}$.)
	Air ($n = 1.00$.)	Water ($n = 1.33$.)	Homogeneous Immersion ($n = 1.52$.)	White Light. ($\lambda = 0.5269 \mu$, Line E.)	Monochromatic (Blue) Light. ($\lambda = 0.4861 \mu$, Line F.)	Photography. ($\lambda = 0.4000 \mu$, Near Line h.)		
1.52	..	..	180° 0'	146,543	158,845	193,037	2.310	.658
1.51	..	..	166° 51'	145,579	157,800	191,767	2.280	.662
1.50	..	..	161° 23'	144,615	156,755	190,497	2.250	.667
1.49	..	..	157° 12'	143,651	155,710	189,227	2.220	.671
1.48	..	..	153° 39'	142,687	154,665	187,957	2.190	.676
1.47	..	..	150° 32'	141,723	153,620	186,687	2.161	.680
1.46	..	..	147° 42'	140,759	152,575	185,417	2.132	.685
1.45	..	..	145° 6'	139,795	151,530	184,147	2.103	.690
1.44	..	..	142° 39'	138,830	150,485	182,877	2.074	.694
1.43	..	..	140° 22'	137,866	149,440	181,607	2.045	.694
1.42	..	..	138° 12'	136,902	148,395	180,337	2.016	.709
1.41	..	..	136° 8'	135,938	147,350	179,067	1.988	.709
1.40	..	..	134° 10'	134,974	146,305	177,797	1.960	.714
1.39	..	..	132° 16'	134,010	145,260	176,527	1.932	.719
1.38	..	..	130° 26'	133,046	144,215	175,257	1.904	.725
1.37	..	..	128° 40'	132,082	143,170	173,987	1.877	.729
1.36	..	..	126° 58'	131,118	142,125	172,717	1.850	.735
1.35	..	..	125° 18'	130,154	141,080	171,447	1.823	.741
1.34	..	..	123° 40'	129,189	140,035	170,177	1.796	.746
1.33	..	180° 0'	122° 6'	128,225	138,989	168,907	1.769	.752
1.32	..	165° 56'	120° 33'	127,261	137,944	167,637	1.742	.758
1.30	..	155° 38'	117° 35'	125,333	135,854	165,097	1.690	.769
1.28	..	148° 42'	114° 44'	123,405	133,764	162,557	1.638	.781
1.26	..	142° 39'	111° 59'	121,477	131,674	160,017	1.588	.794
1.24	..	137° 36'	109° 20'	119,548	129,584	157,477	1.538	.806
1.22	..	133° 4'	106° 45'	117,620	127,494	154,937	1.488	.820
1.20	..	128° 55'	104° 15'	115,692	125,404	152,397	1.440	.833
1.18	..	125° 3'	101° 50'	113,764	123,314	149,857	1.392	.847
1.16	..	121° 26'	99° 29'	111,835	121,224	147,317	1.346	.862
1.14	..	118° 0'	97° 11'	109,907	119,134	144,777	1.300	.877
1.12	..	114° 44'	94° 55'	107,979	117,044	142,237	1.254	.893
1.10	..	111° 36'	92° 43'	106,051	114,954	139,698	1.210	.909
1.08	..	108° 36'	90° 34'	104,123	112,864	137,158	1.166	.926
1.06	..	105° 42'	88° 27'	102,195	110,774	134,618	1.124	.943
1.04	..	102° 53'	86° 21'	100,266	108,684	132,078	1.082	.962
1.02	..	100° 10'	84° 18'	98,338	106,593	129,538	1.040	.980
1.00	180° 0'	97° 31'	82° 17'	96,410	104,503	126,998	1.000	1.000
0.98	157° 2'	94° 56'	80° 17'	94,482	102,413	124,458	.960	1.020
0.96	147° 29'	92° 24'	78° 20'	92,554	100,323	121,918	.922	1.042
0.94	140° 6'	89° 56'	76° 24'	90,625	98,223	119,378	.884	1.064
0.92	133° 51'	87° 32'	74° 30'	88,697	96,143	116,838	.846	1.087
0.90	128° 19'	85° 10'	72° 36'	86,769	94,053	114,298	.810	1.111
0.88	123° 17'	82° 51'	70° 44'	84,841	91,963	111,758	.774	1.136
0.86	118° 38'	80° 34'	68° 54'	82,913	89,873	109,218	.740	1.163
0.84	114° 17'	78° 20'	67° 6'	80,984	87,783	106,678	.706	1.190
0.82	110° 10'	76° 8'	65° 18'	79,056	85,693	104,138	.672	1.220
0.80	106° 16'	73° 58'	63° 31'	77,128	83,603	101,598	.640	1.250
0.78	102° 31'	71° 49'	61° 45'	75,200	81,513	99,058	.608	1.282
0.76	98° 56'	69° 42'	60° 0'	73,272	79,423	96,518	.578	1.316
0.74	95° 28'	67° 37'	58° 16'	71,343	77,333	93,979	.548	1.351
0.72	92° 6'	65° 32'	56° 32'	69,415	75,242	91,439	.518	1.389
0.70	88° 51'	63° 31'	54° 50'	67,487	73,152	88,899	.490	1.429
0.68	85° 41'	61° 30'	53° 9'	65,559	71,062	86,359	.462	1.471
0.66	82° 36'	59° 30'	51° 28'	63,631	68,972	83,819	.436	1.515
0.64	79° 36'	57° 31'	49° 48'	61,702	66,882	81,279	.410	1.562
0.62	76° 38'	55° 34'	48° 9'	59,774	64,792	78,739	.384	1.613
0.60	73° 44'	53° 38'	46° 30'	57,846	62,702	76,199	.360	1.667
0.58	70° 54'	51° 42'	44° 51'	55,918	60,612	73,659	.336	1.724
0.56	68° 6'	49° 48'	43° 14'	53,990	58,522	71,119	.314	1.786
0.54	65° 22'	47° 54'	41° 37'	52,061	56,432	68,579	.292	1.852
0.52	62° 40'	46° 2'	40° 0'	50,133	54,342	66,039	.270	1.923
0.50	60° 0'	44° 10'	38° 24'	48,205	52,252	63,499	.250	2.000
0.45	53° 30'	39° 33'	34° 27'	43,385	47,026	57,149	.203	2.222
0.40	47° 9'	35° 0'	30° 31'	38,564	41,801	50,799	.160	2.500
0.35	40° 58'	30° 30'	26° 38'	33,744	36,576	44,449	.123	2.857
0.30	34° 56'	26° 4'	22° 46'	28,923	31,351	38,099	.090	3.333
0.25	28° 58'	21° 40'	18° 56'	24,103	26,126	31,749	.063	4.000
0.20	23° 4'	17° 18'	15° 7'	19,282	20,901	25,400	.040	5.000
0.15	17° 14'	12° 58'	11° 19'	14,462	15,676	19,050	.023	6.667
0.10	11° 29'	8° 38'	7° 34'	9,641	10,450	12,700	.010	10.000
0.05	5° 44'	4° 18'	3° 46'	4,821	5,252	6,350	.003	20.000

COMPARISON OF THE FAHRENHEIT AND CENTIGRADE THERMOMETERS.

Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.
212	100	158	70	104	40	50	10	- 4	- 20
210.2	99	156.2	69	102.2	39	48.2	9	- 5.8	- 21
210	98.89	156	68.89	102	38.89	48	8.89	- 6	- 21.11
208.4	98	154.4	68	100.4	38	46.4	8	- 7.6	- 22
208	97.78	154	67.78	100	37.78	46	7.78	- 8	- 22.22
206.6	97	152.6	67	98.6	37	44.6	7	- 9.4	- 23
206	96.67	152	66.67	98	36.67	44	6.67	- 10	- 23.33
204.8	96	150.8	66	96.8	36	42.8	6	- 11.2	- 24
204	95.56	150	65.56	96	35.56	42	5.56	- 12	- 24.44
203	95	149	65	95	35	41	5	- 13	- 25
202	94.44	148	64.44	94	34.44	40	4.44	- 14	- 25.56
201.2	94	147.2	64	93.2	34	39.2	4	- 14.8	- 26
200	93.33	146	63.33	92	33.33	38	3.33	- 16	- 26.67
199.4	93	145.4	63	91.4	33	37.4	3	- 16.6	- 27
198	92.22	144	62.22	90	32.22	36	2.22	- 18	- 27.78
197.6	92	143.6	62	89.6	32	35.6	2	- 18.4	- 28
196	91.11	142	61.11	88	31.11	34	1.11	- 20	- 28.89
195.8	91	141.8	61	87.8	31	33.8	1	- 20.2	- 29
194	90	140	60	86	30	32	0	- 22	- 30
192.2	89	138.2	59	84.2	29	30.2	- 1	- 23.8	- 31
192	88.89	138	58.89	84	28.89	30	- 1.11	- 24	- 31.11
190.4	88	136.4	58	82.4	28	28.4	- 2	- 25.6	- 32
190	87.78	136	57.78	82	27.78	28	- 2.22	- 26	- 32.22
188.6	87	134.6	57	80.6	27	26.6	- 3	- 27.4	- 33
188	86.67	134	56.67	80	26.67	26	- 3.33	- 28	- 33.33
186.8	86	132.8	56	78.8	26	24.8	- 4	- 29.2	- 34
186	85.56	132	55.56	78	25.56	24	- 4.44	- 30	- 34.44
185	85	131	55	77	25	23	- 5	- 31	- 35
184	84.44	130	54.44	76	24.44	22	- 5.56	- 32	- 35.56
183.2	84	129.2	54	75.2	24	21.2	- 6	- 32.8	- 36
182	83.33	128	53.33	74	23.33	20	- 6.67	- 34	- 36.67
181.4	83	127.4	53	73.4	23	19.4	- 7	- 34.6	- 37
180	82.22	126	52.22	72	22.22	18	- 7.78	- 36	- 37.78
179.6	82	125.6	52	71.6	22	17.6	- 8	- 36.4	- 38
178	81.11	124	51.11	70	21.11	16	- 8.89	- 38	- 38.89
177.8	81	123.8	51	69.8	21	15.8	- 9	- 38.2	- 39
176	80	122	50	68.2	20	14	- 10	- 40	- 40
174.2	79	120.2	49	66	19	12.2	- 11	- 41.80	- 41
174	78.89	120	48.89	66.4	18.89	12	- 11.11	- 42	- 41.11
172.4	78	118.4	48	64	18	10.4	- 12	- 43.60	- 42
172	77.78	118	47.78	64.6	17.78	10	- 12.22	- 44	- 42.22
170.6	77	116.6	47	62	17	8.6	- 13	- 45.40	- 43
170	76.67	116	46.67	62.8	16.67	8	- 13.33	- 46	- 43.33
168.8	76	114.8	46	60	16	6.8	- 14	- 47.20	- 44
168	75.56	114	45.56	60	15.56	6	- 14.44	- 48	- 44.44
167	75	113	45	59	15	5	- 15	- 49	- 45
166	74.44	112	44.44	58	14.44	4	- 15.56	- 50	- 45.56
165.2	74	111.2	44	57.2	14	3.2	- 16	- 50.80	- 46
164	73.33	110	43.33	56	13.33	2	- 16.67	- 52	- 46.67
163.4	73	109.4	43	55.4	13	1.4	- 17	- 52.60	- 47
162	72.22	108	42.22	54	12.22	0	- 17.78	- 54	- 47.78
161.6	72	107.6	42	53.6	12	- 0.4	- 18	- 54.40	- 48
160	71.11	106	41.11	52	11.11	- 2	- 18.89	- 56	- 48.89
159.8	71	105.8	41	51.8	11	- 2.2	- 19	- 56.20	- 49
								- 58	- 50



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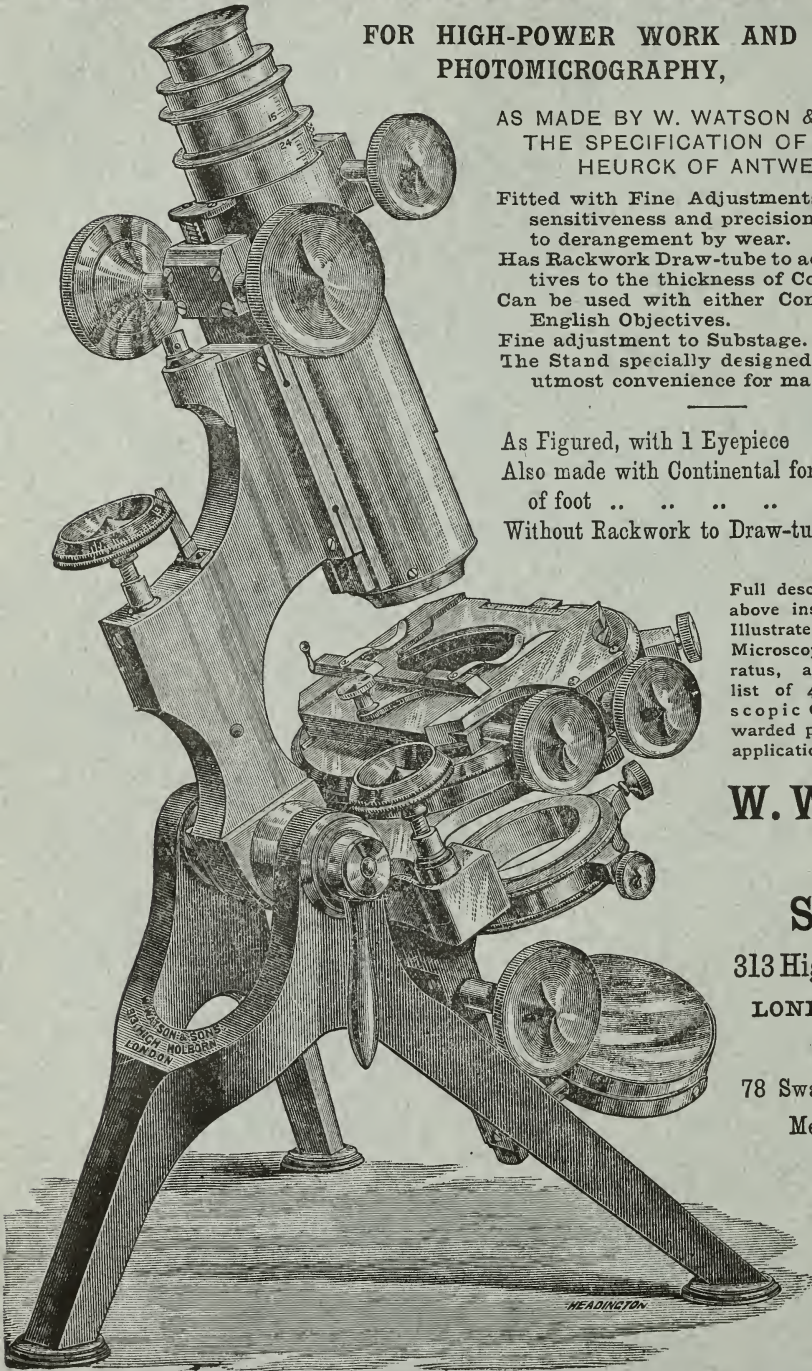
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JOURNAL
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DECEMBER 1892.

TRANSACTIONS OF THE SOCIETY.

XI.—*Algæ of the English Lake District.*

By WM. WEST, F.L.S.

(Read 16th November, 1892.)

PLATES IX. AND X.

SEVERAL valuable papers have already appeared in this Journal relating to this subject; there was one by Mr. Bissett in 1884, and since that, two by Mr. A. W. Bennett in 1886 and 1888. As I have practically made collections yearly since 1879 from numerous localities, I am enabled to offer the following contribution to the already large

EXPLANATION OF PLATES.

(Explicatio iconum.)

- a, a', a''* = front view (a fronte visa).
b, b' = vertical view (a vertice visa).
c = side view (a latere visa).
d = basal view of semicell (a basi visa).

PLATE IX.

- Fig. 1.—*Closterium abruptum* sp. n. × 520.
" 2. " *turgidum* Ehrnb. var. *decoratum* var. n. Cell membrane × 830.
" 3.—*Sphærozosma vertebratum* (Bréb.) Ralfs forma *minor* West. × 520.
" 4.—*Spondylosium pygmæum* (Cooke) West var. *compressum* var. n. × 400.
" 5.—*Micrasterias denticulata* Bréb. var. *subnotata* var. n. × 220.
" 6.—*Euastrum binale* (Turp.) Ralfs var. *retusum* var. n. × 520.
" 7.—*Penium* sp. × 520.
" 8.—*Cosmarium obcuneatum* West forma. × 520.
" 9.—*Euastrum elegans* (Bréb.) Kütz. var. *ornatum* var. n. × 520.
" 10.—*Cosmarium morsum* sp. n. × 520.
" 11. " *coarctatum* sp. n. × 520.
" 12. " *Holmiense* Lund. var. *integrum* Lund forma. × 400.
" 13.—*Closterium obtusum* Bréb. forma. × 520.
" 14.—*Cosmarium Meneghini* Bréb. forma (c. zygosp.). × 520.
" 15. " *obliquum* Nordst. forma *minima*. × 520.
" 16. " *pseudarctoum* Nordst. × 520.
" 17.—*Euastrum erosum* Lund. var. *notabile* var. n. × 520.
" 18.—*Cosmarium subpunctulatum* Nordst. var. *Boergesenii* West forma. × 520.
" 19. " *cyclicum* Lund. var. *angulatum* West. × 520.
" 20. " *Regnellii* Wille forms. × 520.
" 21. " *pseudatlanthoideum* sp. n. × 520.
" 22. " *subcylindricum* sp. n. × 520.

1892.

3 c

number of species on record. No species is here recorded for any locality in which it has been found previously; but almost every species recorded in the paper of Mr. Bissett and those by Mr. Bennett has been again seen from the same localities.

The gatherings covered most of the Lake District proper, and Mr. W. H. Youdale kindly made a few gatherings for me from near Cockermouth, Embleton, Crummock Water, and Bassenthwaite Water.

There are 589 species and 78 varieties in this paper, one genus, 21 species, and 23 varieties of which are here described for the first time, and in addition to the latter, there are 27 species and 10 varieties recorded as new to the British Isles (prefixed by an asterisk).

In the preparation of this paper—as in former papers—I have again to acknowledge the invaluable help of my son, G. S. West (National Scholar in Biology), who also assisted in making the collections from near Bowness. The locality “Bowness” includes pools near there with *Nymphæa alba* and *Utricularia*, small pools with the latter on Brant Fell, and other suitable places as far as Lindeth where many gatherings were made.

-
- Fig. 23.—*Cosmarium cymatonotophorum* sp. n. a, × 830; a', a'', b, et c × 520.
 ,, 24. „ *supraspectiosum* Wolle var. *emarginatum* var. n. × 520.
 ,, 25.—*Staurastrum arcuatum* Nordst. subsp. *subavicula* subsp. n. × 520.
 ,, 26. „ *Brebissonii* Arch. var. *brevispinum* var. n. × 400.
 ,, 27.—*Arthrodesmus glaucescens* Wittr. forma *convexa* West (c. zygosp.). × 520.
 ,, 28.—*Staurastrum ellipticum* sp. n. × 400.
 ,, 29.—*Cosmarium subcapitulum* sp. n. × 520.
 ,, 30. „ *Clepsydra* Nordst. × 520.
 ,, 31.—*Cosmarium ochlithodes* Nordst. var. *amæbum* var. n. Verrucæ × 830.
 ,, 32. „ *microsphinctum* Nordst. × 520.
 ,, 33. „ *vevatum* sp. n. × 520.
 ,, 34.—*Staurastrum sexcostatum* Bréb. subsp. *productum* subsp. n. × 520.
 ,, 35. „ *polymorphum* Bréb. var. *munitum* var. n. × 520.
 ,, 36. „ *gracile* Ralfs var. *coronulatum* Boldt, f. 3-gona. × 520.
 ,, 37. „ *Pseudosebaldi* Wille var. *simplicior* var. n. × 520.
 ,, 38. „ *vestitum* Ralfs var. *semivestitum* var. n. × 520.
 ,, 39.—*Dimorphococcus lunatus* A. Br. × 520.

PLATE X.

- ,, 40-42.—*Cylindrocapsa conferta* sp. n. × 520.
 ,, 43-46.—*Tetracoccus botryoides* gen. et sp. n. × 520.
 ,, 47-48.— „ „ „ Two groups of four cells. × 830.
 ,, 49.—*Nephrocytium lunatum* sp. n. × 520.
 ,, 50.—*Selenastrum obesum* sp. n. × 520.
 ,, 51. „ „ „ Two separate cells. × 830.
 ,, 52. „ „ „ × 520.
 ,, 53.—*Tetraëdron gigas* (Wittr.) Hansg. var. *manillata* var. n. × 520.
 ,, 54.—*Trochiscia uncinata* sp. n. × 520.
 ,, 55.—*Chlorococcum regulare* sp. n. × 520.
 ,, 56.—*Oocystis elliptica* sp. n. × 520.
 ,, 57.—*Schizochlamys delicatula* sp. n. × 520.
 ,, 58.—*Lyngbya subtile* sp. n. × 830.
 ,, 59 & 60.—*Chroococcus giganteus* sp. n. × 520.
 ,, 61-63. „ *schizodermaticus* sp. n. × 520.
 ,, 64.—*Celastrum sphaericum* Näg. × 520.

The following contractions are used:—B. for Brother's Water; Bn. for Bowness; Bo. for Borrowdale; Bt. for Blea Tarn, Westmoreland; C. for Bogs around Cockley Beck (Lancashire); H. for Helvellyn; Hk. for pool, Hawkshead to Yewdale; Hp. for Harrop Tarn; L. for Loughrigg; R. for Rydal Fell; S. for Scandale; Sk. for near Stickle Tarn; W. for Wastdale and Wast Water.

ALGÆ.

Class FLORIDEÆ.

Order HELMINTHOCLADIE.

Genus *Batrachospermum* Roth.

B. moniliforme Roth. Threlkeld.

Order LEMANEACEÆ.

Genus *Lemanea* Bory.

L. fluviatilis Ag. H., Foot of Bow Fell, near Angle Tarn.

L. torulosa (Roth.) Ag. S.

Class CONFEROIDEÆ HETEROGAMÆ.

Order COLEOCHÆTACEÆ.

Genus *Coleochæte* Bréb.

C. scutata Bréb. B., R., Crummock Water.

Order ŒDOGONIACEÆ.

Genus *Bulbochæte* Ag.; Pringsh.

? *B. setigera* (Roth.) Ag. (sterile). Bn., S., R., Bassenthwaite Water, Grisedale Tarn.

B. rectangularis Wittr. L.

Genus *Œdogonium* Link; Pringsh.

Œ. cryptoporum Wittr. Blea Tarn in Borrowdale.

var. *vulgare* Wittr. Forma cellulis longioribus. Bn.

Œ. Itzigsohnii De Bary. Hp.

Œ. undulatum (Bréb.). A., Br., S.

Œ. calcareum Cleve. Bn.

Class CONFEROIDEÆ ISOGAMÆ.

Order CONFERVACEÆ.

Genus *Conferva* (Linn.) Link; Wille.

**C. Wittrockii* Wille.

Lat. fil. 12–13 μ . Bo., Hawkshead.

**C. Raciborskii* Gutw. Bassenthwaite Water.

C. bombycina Ag.
 forma *genuina* Wille. Bn., H., Deep Dale, Angle Tarn.
 forma *minor* Wille. Common.

C. floccosa (Vauch.) Ag. B., H., Crummock Water.

Genus *Cladophora* Kütz.

C. crispata (Roth) Kütz. Embleton.

Genus *Chætophora* Schrank.

C. elegans (Roth) Ag. R.

Genus *Draparnaldia* Bory.

D. glomerata (Vauch.) Ag. Bn., Crummock Water.

D. plumosa Ag. Buttermere.

Genus *Stigeoclonium* Kütz.

S. fastigiatum (Ralfs) Kütz. Crummock Water.

Genus *Microthamnion* Näg.

M. vexator Cooke. Hk.

Genus *Aphanochæte* A. Br.

A. globosa (Nord.) Wolle.

forma *minor* Nord.

Diam. cell 10–11 μ . Bn., Hp., R., Sk.

Order ULOTRICHACEÆ.

Genus *Ulothrix* Kütz.

U. parietina Kütz. Sk.

U. tenerrima Kütz. Langdale.

Genus *Schizogonium* Kütz.

S. murale Kütz. H.

Genus *Hormiscia* Aresch.

H. moniliformis (Kütz.) Rabh. S.

H. zonata (Web. and M.) Aresch. B., Crummock Water.

forma *major*.

Lat. cell. 47–50 μ . H.

H. æqualis (Kütz.) Rabh.

var. *catenæformis* (Kütz.) Near Cockermonth.

CLASS CONJUGATEÆ.

Order MESOCARPEÆ.

Genus *Mougeotia* (Ag.) Wittr.

M. nummuloides Hass. Scarf Gap Pass, Kirk Fell.

M. recurvus (Hass.) De Toni. Bo., Bassenthwaite Water.

M. parvula Hass.

forma sporis rotundo-ellipticis.

Long. spor. 15–16 μ ; lat. spor. 12·5–14 μ ; Bassenthwaite Water.

M. quadrangulata Hass. [*M. quadrata* (Hass.) Wittr.]

forma minor.

Crass. cell. veget. 7–7·5 μ ; diam. spor. 28–30 μ . Bassenthwaite Water.

M. viride (Kütz.) Wittr. Bn.

M. gracillima (Hass.) Wittr. B., H. (at 2400 ft.).

? *M. elegantula* Wittr.

Crass. cell. veget. 5 μ (sterile). Bn.

All the species of *Mougeotia* were in abundant conjugation except the last.

Order ZYGNEMACEÆ.

Genus *Sirogonium* Kütz.

S. sticticum (Eng. Bot.) Kütz. H.

Genus *Spirogyra* Link.

S. tenuissima (Hass.) Kütz.

Forma cellulis fructiferis subtumidis.

Lat. cell. fruct. 27–30 μ ; long. zygosp. 60–64 μ ; lat. zygosp. 23–25 μ . Bn.

This approaches var. *plena* Lagerh. (Contrib. Fl. Alg. del Ecuador, p. 7).

S. flavescens (Hass.) Kütz.

forma. Lat. cell. veg. 14–16 μ ; long. zygosp. 53–55 μ ; lat. zygosp. 22–23 μ . Esthwaite Water.

S. gracilis (Hass.) Kütz.

Forma zygosporis solum diametro 1½-plo longioribus.

Lat. cell. veg. 19 μ ; lat. cell. fruct. 39–41 μ ; long. zygosp. 42–44 μ ; lat. zygosp. 27–30 μ . Bn.

S. varians (Hass.) Kütz. Black Sail Pass.

Forma cellulis sterilibus minoribus et zygosporis diametro 1½-plo longioribus.

Lat. cell. ster. 21 μ ; long. zygosp. 34 μ ; lat. zygosp. 25 μ . Bo.

**S. Lutetiana* P. Petit var. MINOR var. n.

Var. duplo minor quam forma typica, cellulis vegetativis diametro 8-plo longioribus; zygosporis cylindrico-oblongis, diametro 3–4-plo longioribus.

Lat. cell. veget. 19 μ ; long. zygosp. 50–63 μ ; lat. zygosp. 18–19 μ . Bo.

S. nitida (Dillw.) Link. Bn.

Only occasional zygospores.

Genus *Zygnema* Ag.

Many sterile species, from various localities, were seen, but none were observed in conjugation.

Genus *Debarya* Wittr.

D. glyptosperma (De Bary) Wittr. R.

Order DESMIDIACEÆ.

Genus *Gonatozygon* De Bary.

G. Ralfsii De Bary. L., B., R., C., Brandreth.

G. Brebissonii De Bary. L., B., R., S., Brandreth.

G. minutum West. Bn., Sty Head Tarn.

**G. Kjellmani* Wille.

Forma minor et recta.

Long. 58μ ; lat. $6-6.5 \mu$. Bo.

Genus *Sphærozozma* Corda.

S. vertebratum (Bréb.) Ralfs. B., R., Bassenthwaite Water.

forma *minor* West (Addit. to the Freshw. Alg. of W. Yorks. in Naturalist, 1891, p. 244). Fig. 3. Hp., Sk., B., R.

S. excavatum Ralfs. Frequent.

S. granulatum Roy et Biss. Bn., W.

Genus *Spondylosium* Bréb.

S. pulchellum Arch. Hp., Grisedale Tarn.

S. pygmæum (Cooke) West (Contrib. Fr. Wat. Alg. of W. Ireland, p. 116).

var. COMPRESSUM var. n. Fig. 4.

Var. cellulis subquadrangularibus, compressis ad polos.

Long. cell. $5.5-6 \mu$; lat. cell. 7μ ; lat. isthm. 2.5μ . B.

Genus *Onychonema* Wallich.

O. filiforme (Ehrnb.) Roy et Biss. Bn.

Genus *Hyalotheca* Ehrnb.

H. dissiliens (Sm.) Bréb. Very frequent.

At 2400 ft. on Helvellyn. It was seen with zygospores from Harrop Tarn, Bowness, Loughrigg and Hawkshead.

forma *bidentula* (Nordst.) Boldt. B., Bn., L., Sk.

var. *hians* Wolle. Bt., Sk., C., Hk., Lake Side.

*var. *tatrica* Racib. (Nonn. Desm. Polon., p. 8, t. xiv. f. 5).

Long. cell. 20μ ; lat. $16-16.5 \mu$. Hk.

H. mucosa (Dillw.?) Ehrnb. B., R., S.

Genus *Gymnozyga* Ehrnb.

G. moniliformis Ehrnb. Hp., W., Sk., C., Hk.

Genus *Desmidiium* Ag.

D. cylindricum Grev. L.

D. Swartzii Ag. W., B., R., Hk., Deepdale, H. (at 2400 ft.).

D. aptogonum Bréb. L., S.

var. *acutius* Nordst. Bn.

Genus *Pleurotænium* Näg.

P. coronatum (Bréb.) Rabh. B.

var. *nodulosum* (Bréb.) West. [*Docidium coronatum* Bréb. var. *nodulosum* (Bréb.) Roy]. Bo.

P. Ehrenbergii (Ralfs.) De Bary. Frequent.

P. clavatum (Kütz.) De Bary. B.

P. maximum (Reinsch) Lund.

var. OCCIDENTALE var. n. [*P. maximum* West (Contrib. Freshw. Alg. of W. Ireland, p. 119)].

Var. ad formam typicam similis sed ter minor est. W., Bn., Hk.

This is $2\frac{1}{2}$ to $3\frac{1}{2}$ times smaller, but in form it agrees exactly with the species described by Reinsch (Alg. Fl. von Mitt. Frank., p. 184, t. 12, f. iv.). It is quite distinct from *P. Ehrenbergii* (Ralfs) De Bary.

P. truncatum (Bréb.) Näg. Bo.

Genus *Closterium* Nitzsch.

C. didymotocum Corda. C., Hk.

C. ABRUPTUM sp. n. Fig. 1.

Cl. anguste lanceolatum, circiter decies longius quam latius, leve curvatum, latere ventrali non (vel levissime) tumidum, sensim æqualiter attenuatum utrimque in apicem truncatum; membrana luteola et non-striata; pyrenoidibus 8-10 in unica serie.

Long. 127-156 μ ; lat. ad medium 12-15.5 μ ; lat. apic. 6-7 μ . C., Hk., Esthwaite Water, Ennerdale.

This is similar in shape to some forms of *Cl. intermedium* Ralfs, but differs in its much smaller size and in its membrane not being striolated.

forma PUNCTATA.

Forma membrana irregulariter punctata. C.

C. obtusum Bréb.

Forma apicibus subtruncatis.

Long. 41 μ ; lat. 7.5 μ . Fig. 13. H.

C. lunula (Müller) Nitzsch. Frequent.

- C. lanceolatum* Kütz. Bo., Bn., near Cockermouth.
C. turgidum Ehrnb. Bo., C., Hk.
 Long. 750–791 μ ; lat. 66–75 μ .
 var. *DECORATUM* var. n. Fig. 2.
 Cl. striis prope medium punctorum factis, apices versus
irregulariter punctatum (nec in lineis).
 Long. 510 μ ; lat. 43 μ . Bn.
C. praelongum Bréb. Bn.
C. strigosum Bréb. S.
C. gracile Bréb. Hk.
C. Ehrenbergii Menegh. Bo., H. (at 2400 ft.), Deepdale, Crum-
 mock Water, Vale of Newlands.
C. moniliferum (Bory) Ehrnb. H. (at 2400 ft.), near Cocker-
 mouth, Vale of Newlands.
C. Jenneri Ralfs. Bo., L., Hk., Brandreth.
C. Leibleinii Kütz. B.
C. Dianæ Ehrnb. Frequent. Occurs up to 2400 ft. on
 Helvellyn.
C. parvulum Näg. Hk.
C. Venus Kütz. B., L., Bn., Hk.
C. Cynthia De Not. Hk.
C. Archerianum Cleve. Bn.
C. costatum Corda. W., S., B., Deepdale.
C. striolatum Ehrnb. Frequent.
 var. *orthonotum* Roy. W., Grisedale Tarn.
C. intermedium Ralfs. W., R., C., Grisedale Tarn.
C. angustatum Kütz. Bt., C., Hk.
C. juncidum Ralfs. Bo., C., Hk., Brandreth.
C. lineatum Ehrnb. W., Hk.
C. attenuatum Ehrnb. Hk.
C. Ralfsii Bréb.
 var. *hybridum* Rabh. Bn., L., Hk.
 Long. 600–616 μ ; lat. 41–43 μ .
C. rostratum Ehrnb. Bn. (cum zygosp.), Derwent Water (cum
 zygosp.), near Blea Tarn.
C. setaceum Ehrnb. W.
C. Kützingii Bréb. Bt. (cum zygosp.), Hk.
C. Cornu Ehrnb. S., Bn., H., Derwent Water.
 forma *major* Wille. Bn.
C. acutum Bréb. B., Threlkeld.
C. linea Perty. B., Bn.

Genus *Penium* Bréb.; De Bary.

- P. margaritaceum* (Ehrnb.) Bréb. C.
P. cylindrus (Ehrnb.) Bréb. H., Hk.
P. spirostriolatum Bark. Hp., S., C., Hk.
P. digitus (Ehrnb.) Bréb. Very frequent.

- P. interruptum* Bréb. Hk.
P. closterioides Ralfs. W., S., Hk., near Cockermouth.
 forma INTERRUPTA.
 Forma massa chlorophyllacea in partibus quattuor divisa.
 Long. 122–125 μ ; lat. 24–26 μ . Black Sail Pass.
P. Navicula Bréb. Bo., Hp., W., L., C., Buttermere.
 Forma Wille (Bidrag til Kundsk. om Norges Ferskv.
 Alg., p. 49, t. ii. f. 32). Bn., H., Langdale.
P. curtum Bréb.
 forma *minor* Wille. H.
 forma *minuta*.
 Long. 22 μ ; lat. 10·5 μ ; lat. isthm. 10 μ . C.
P. truncatum Ralfs. C.
P. didymocarpum Lund.
 Long. 31–34 μ ; lat. 13–14 μ ; long. zygosp. 22–24 μ ;
 lat. zygosp. 31–33 μ . Hk.
P. polymorphum Perty. Hp., Hk., Buttermere, Grisedale Tarn,
 Scarf Gap Pass, Brandreth, Blea Tarn in Borrowdale.
P. Clevei Lund.
 Long. 96 μ ; lat. 42 μ ; lat. isthm. 39 μ . Bn.
P. cucurbitinum Biss. H., Trough at Ambleside.
P. minutum (Ralfs) Cleve. W., Hk.
P. sp. Long. 27–30 μ ; lat. 10 μ . Fig. 7. Pike of Bliscoe.

Genus *Cylindrocystis* Menegh.

- C. Brebissonii* Menegh. Very frequent. Zygospores seen from
 Stickle Tarn.
C. crassa De Bary. H., H., Sk., Kirk Fell.
C. diplospora Lund. Sk., Hk.

Genus *Tetmemorus* Ralfs.

- T. Brébissonii* (Menegh.) Ralfs. Hp., Sk., C., Buttermere,
 Scawfell.
 var. *minor* De Bary. Hk., Brandreth.
T. granulatus (Bréb.) Ralfs. Common.
 f. *minor* Nordst. Sk.
 var. *attenuatus* West. Sk., Bt., Hk.
T. lævis (Kütz.) Ralfs. Common.

Genus *Spirotænia* Bréb.

- S. condensata* Bréb. Bo., Hk.

Genus *Mesotænium* Näg.

- M. micrococceum* (Kütz.) Kirchn. Sk.
M. mirificum Arch. Sk.
M. De Greyii Turn. Bn.

Genus *Micrasterias* Ag.

M. mucronata (Dixon) Rabh. Bo., Sk., Kirk Fell, Grisedale Tarn.

M. Crux-Melitensis (Ehrnb.) Ralfs. f. *punctulata*.

Forma membrana irregulariter punctulata (subgranulosa).
Bn.

The punctulations cause the margin of this form to appear minutely papillate.

M. Americana (Ehrnb.) Ralfs. Deepdale.

M. angulosa Hantzsch. C.

M. denticulata Bréb. Frequent.

*var. *angustosinuata* Gay (Essai d'une monograph. des
Conjug., p. 52, pl. i. fig. 4). L.

var. *SUBNOTATA* var. n. Fig. 5.

Semicellulæ a vertice visæ cum elevatione mediana
latissime conica, lobi polari medio dentibus duobus
parvis.

Lat. 170 μ ; crass. 50 μ . Bn.

Compare with *M. denticulata* var. *notata* Nordst. (Freshw.
Alg. of New Zeal. and Austr., p. 29, t. 2, f. 13).

M. rotata (Grev.) Ralfs. Bo., B., S., C., H. (at 2400 ft.),
Deepdale.

M. Thomasiana Arch. C.

M. radiosa Ralfs. Bn.

M. apiculata (Ehrnb.) Menegh. subsp. *fimbriata* (Ralfs) Nordst.
Bn.

M. papillifera Bréb. Bo., Hk.

M. truncata (Corda) Bréb. Frequent.

forma *punctata* West. Bo., C.

forma *granulata* Racib. Hk.

M. Jenneri Ralfs. Sk.

var. *simplex* West. (*M. Jenneri* f. *brasiliensis* Boerg.)
Sk.

Genus *Euastrum* Ehrnb.

E. verrucosum Ehrnb. B., W., S., R., Hk.

E. oblongum (Grev.) Ralfs. Frequent.

E. crassum (Bréb.) Kütz. W., C., Kirk Fell.

E. ventricosum Lund. Hk.

E. pinnatum Ralfs. Hk.

E. humerosum Ralfs. Bt.

E. affine Ralfs. Bt., B., C., Scawfell, Brandreth, Kirk Fell,
Black Sail Pass.

E. ampullaceum Ralfs. Bt., Hk., Brandreth, Kirk Fell, Black
Sail Pass.

E. insigne Hass. Frequent.

E. didelta Ralfs. W., B., C., Hk., H. (at 2400 ft.), Black Sail Pass, Deepdale.

E. cuneatum Jenner. Hp., C., Hk., Black Sail Pass, Scawfell, Kirk Fell.

E. ansatum Ehrnb. Frequent.

E. circulare Hass. H.

E. sinuosum Lenorm. W., L., Hk., Bt.

E. pectinatum Bréb. Frequent.

E. gemmatum Bréb. Hk.

E. rostratum Ralfs. B., Hk.

E. elegans (Bréb.) Kütz. Very frequent.

var. *bidentatum* Næg. H., B., S., Hk.

var. *ORNATUM* var. n. Fig. 9.

Semicellulæ verrucis sex ad medium, in seriebus transversis duabus, cum granulo intus extraque ad angulos inferiores ornatæ, etiam cum granulis binis prope basem incisionis polaris.

Long. 47 μ ; lat. 29 μ ; lat. isthm. 8 μ ; crass. 14 μ .
Hp., Sk., Bn.

E. erosum Lund. var. *NOTABILE* var. n. Fig. 17.

Semicellulæ lateribus bilobulatis, lobo polari quadrato-truncato, anguste vel sublate inciso, intra marginem granulis instructis, duo ad apicem, quattuor prope incisionem, et unum supra medium; a vertice visæ angustiores quam forma typica, lateribus subrectis.

Long. 31–33 μ ; lat. 20–21 μ ; lat. isthm. 4–6 μ ; crass. 10 μ . H., S., Sk., L.

E. pyramidatum West. L.

E. binale (Turp.) Ralfs. Frequent.

forma *hians* West. C.

var. *elobatum* Lund. Bo., H., B., C., Bassenthwaite Water.

var. *RETUSUM* var. n. Fig. 6.

Var. semicellulis distincte punctatis, inflatione medio granulato, apice late retusa (nec incisa).

Long. 27 μ ; lat. 21 μ ; lat. isthm. 8 μ ; crass. 12 μ .
Kirk Fell.

E. denticulatum (Kirchn.) Gay. Frequent.

Genus *Cosmarium* Corda; Ralfs.

C. quadratum Ralfs. H., Hk., Deepdale.

C. plicatum Reinsch. Near Blea Tarn.

C. sublobatum (Bréb.) Arch. H., Bo., Scarf Gap Pass.

C. tatricum Racib. var. *novizelandicum* Nordst. (Freshw. Alg. of New Zeal. and Austr., p. 56, t. 6, f. 6).

Long. 46 μ ; lat. 25 μ ; lat. isthm. 14 μ ; crass. 12 μ .
Kirk Fell.

C. Nymmannianum Grun. Hp.

C. Hammeri Reinsch. H., Bt., Bo., Deepdale, Bassenthwaite Water, Sty Head Tarn.

**C. Clepsydra* Nordst. (Desm. Brasil., tab. iii. fig. 29. *C. bicardia* Reinsch.).

Long. 21 μ ; lat. 21 μ ; lat. isthm. 4.5 μ ; crass. 16 μ .
Fig. 30. Bn.

C. COARCTATUM sp. n. Fig. 11.

C. parvum, paullo longius quam latius, leviter constrictum, sinu subaperto et obtuso; semicellulæ obtrapezicæ, marginibus lateralibus subrectis, apice late truncatæ; a vertice visæ ellipticæ; a latere visæ subcirculares, apice truncatæ; membrana lævis et subincrassata ad apices.

Long. 16 μ ; lat. ad bas. semicell. 12–12.5 μ ; lat. ad apic. 13.5–14.4 μ ; lat. isthm. 7 μ ; crass. 8 μ . Bo.

This seems at first sight very similar to *C. contractum* Kirchn. var. *cracoviense* Racib. (Nonn. Desm. Polon., p. 28, t. 1, f. 10) but is much smaller and has more truncate ends, a relatively wider isthmus, and a different lateral view.

C. Holmiense Lund. var. *integrum* Lund. H.

Forma cellulis a latere visis pyramidatis et a vertice visis nec late ellipticis.

Long. 52 μ ; lat. 30 μ ; lat. isthm. 16 μ ; crass. 17.5 μ .
Fig. 12. B.

C. anceps Lund. Bn., R.

C. granatum Bréb. B., Bo., L., C., Hk., Esthwaite Water.

C. trilobulatum Reinsch. Bn.

Long. 23 μ ; lat. 15.4 μ ; lat. isthm. 5 μ .

C. tetragonum Næg. H.

var. *Lundellii* Cooke. B.

C. variolatum Lund. Hk., L.

C. obsoletum (Hantzsch) Reinsch. Bn., Hk.

The vertical view was somewhat pointed at each pole just as in Nordst. Alg. et Char. I., tom. xvi. fig. 9*b*, and not as in Reinsch, Algenflora von Mitt. Frank., taf. ix. fig. 5*d*.

C. cymatopleurum Nordst. Bn.

* var. *tyrolicum* Nordst. in Wittr. et Nordst., Desm. et Edog. in Tyrol, p. 30, tab. xii. fig. 5. Hk., not uncommon.

C. pachydermum Lund. Bo., H., C.

C. perforatum Lund. Bn.

C. pyramidatum Bréb. Frequent.

C. pseudopyramidatum Lund. Frequent.

**C. microsphinctum* Nordst. in Wittr. et Nordst., l.c. p. 33, t. f. 9.

Long. 39 μ ; lat. 26 μ ; lat. isthm. 17.5 μ ; crass. 18.5 μ .
Fig. 32. Bo.

C. nitidulum De Not. H., Bo., Wythburn, Kirk Fell.

C. subtumidum Nordst. H.

C. tumidum Lund. L.

C. Phaseolus Bréb. H., Scawfell, Scarf Gap Pass, Sty Head Tarn.

C. PSEUDATLANTHOIDEUM sp. n. Fig. 21.

C. parvum, $1\frac{1}{2}$ -plo longius quam latius, profunde constrictum, sinu lineari; semicellulæ subtriangulares, angulis inferioribus latissime rotundatis, lateribus concavis, apice angusto rotundato; a vertice visæ anguste ellipticæ; membrana glabra.

Long. $19\cdot5\ \mu$; lat. $13\cdot5\ \mu$; lat. isthm. $4\ \mu$; crass. $6\cdot5\ \mu$. L.

This differs from *C. atlantioideum* Delp. in being relatively narrower and in its different vertical view.

C. scenedesmus Delp. B., Bn.

C. rectangulare Grun. Bt., Hk.

C. bioculatum Bréb. Sk., B., Hk.

*forma *depressa* Schaar. B.

C. tinctum Ralfs. Frequent.

*var. *intermedium* Nordst.

Long. $14\text{--}15\ \mu$; lat. $10\text{--}12\ \mu$; lat. isthm. $6\ \mu$; crass. $8\ \mu$; Bo. Frequent.

C. exiguum Arch. Hk.

**C. Regnellii* Wille (Bidrag til Sydam. Algfl., p. 16, t. i. f. 34). Hk., common.

Long. $11\text{--}12\ \mu$; lat. $11\text{--}14\ \mu$; lat. isthm. $3\cdot5\text{--}4\ \mu$; crass. $6\ \mu$. Fig. 20.

The forms of this varied considerably. Perhaps *C. abruptum* Lund. var. *gostyniense* Racib. (Nonn. Desm. Polon., p. 24, t. ii. f. 13) may be another form of this species.

C. SUBCAPITULUM sp. n. Fig. 29.

C. parvum, paullo latius quam longius, profunde constrictum, sinu acutangulo aperto; semicellulæ elliptico-angulares; latera inferiora et superiora recta angulum subrectangularem formantia; apicibus truncatis et subretusis; a vertice visæ ellipticæ polis acutis; a latere visæ rotundo-ellipticæ; membrana lævis.

Long. $17\ \mu$; lat. $19\ \mu$; lat. isthm. $4\ \mu$; crass. $7\cdot5\ \mu$. Bn.

This differs from *C. capitulum* Roy et Biss. (Jap. Desm. in Journ. Bot., 1886, vol. 25, p. 195, t. 268, f. 9) in the truncate subretuse ends, the acute angles of the semicells, in the non-acuminate sinus, and in the subacute poles of the vertical view.

- C. impressulum* Eلفv. B., Hk.
C. venustum (Bréb.) Arch. L., C., Brandreth, Grisedale Tarn.
 var. *hypohexagonum* West. Kirk Fell.
 f. *incrassata* West. Sk.
C. Meneghini Bréb. Very frequent.
 f. *octangularis* Wille. Frequent.
 forma. Fig. 14. Diam. zygosp. sine spin. 22–23 μ , c.
 spin. 33–35 μ . Bn.
 f. *Boldtii* nob. [*C. Meneghini* Bréb. forma h. Boldt
 (Desmid. fr. Grönland, p. 13, t. i. fig. 15.)] Bt., Hk.,
 common.
C. obliquum Nordst. f. *major* Nordst. Hk.
 f. *minor* Nordst. Bn., Langdale.
 f. *minima*.
 Long. 11 μ ; lat. 9 μ ; crass. 4 μ . Fig. 15. H., Pike of
 Bliscoe.
C. Regnesii Reinsch. B., Esthwaite Water.
C. CYMATONOTOPHORUM sp. n. Fig. 23.
C. parvum, tam longum quam latum, modice constrictum,
 sinu aperto cum extremo obtuso; semicellulæ late subrectan-
 gulares, lateribus subtruncatis subretusisve, dorso truncato et
 quadriundulato; a vertice visæ ellipticæ, in utroque latere
 papilla instructæ; a latere visæ suborbiculares, medio utrobique
 papilla ornata.
 Long. 13·5–14·5 μ ; lat. 13·5–14·5 μ ; lat. isthm.
 5·5–6 μ ; crass. 9·8 μ . Hk.
 This seems a very distinct species; it has some resemblance in
 front view on first sight to *C. Regnesii* Reinsch.
C. substriatum Nordst. Bn., Sty Head Tarn.
 **C. subnotabile* Wille (Ferskv. Alg. fr. Nov. Sem., p. 36, tab. xii.
 fig. 16). Trough at Ambleside.
C. crenatum Ralfs. Frequent.
C. Nuttallii West. Bt.
C. undulatum Corda. H.
C. monomazum Lund. B.
C. tetraophthalmum (Kütz.) Bréb. Frequent. The zygospore
 was seen from Lake Side.
 var. *Lundellii* Wittr. Bo., Bn., R., C., Hk., Blea Tarn
 in Borrowdale.
C. Brebissonii Menegh. W., Bo., Hp., B., S., C.
 forma *erosa* West. W., Hp., Bn., S., L., C., Bt.
C. conspersum Ralfs. Bo., B., L., C., Hk.
C. Quadrum Lund.
 Long. 73 μ ; lat. 70 μ ; lat. isthm. 28 μ . Bn., Hk.
C. margaritifera (Turp.) Menegh. H. (at 2400 ft.). B.
 Scawfell, Crummock Water.

C. Portianum Arch. B., Bo., H., R., Bt., Hk., Blea Tarn, in Borrowdale.

C. reniforme (Ralfs.) Arch. B., Hk., Bassenthwaite Water.

*var. *compressum* Nordst. (Freshw. Alg. of New Zeal. and Austr., p. 46, t. 5, f. 5).

Long. 48 μ ; lat. 47 μ ; lat. isthm. 13 μ ; crass. 24 μ .
Hk.

C. Logiense Biss. Frequent.

C. punctulatum Bréb. B., H., Crummock Water, Trough at Ambleside.

C. subpunctulatum Nordst. var. *Borgesenii* West.

Forma semicellulis ad apices leviter convexis, in medio granulis paullo majoribus (7 periphericis et 1 centrali).

Long. 33 μ ; lat. 30 μ ; lat. isthm. 11 μ ; crass. 19 μ .
Fig. 18. C., Hk., Langdale.

The centre granules in var. *Borgesenii* West (Contrib. Freshw. Alg. of W. Ireland, plate 21, fig. 9) have been drawn like the others by the artist; they should have been made larger.

C. Blyttii Wille. Hp., Wythburn.

Forma paullo minor. Lat. 10 μ ; crass. 7 μ . H. (at 2400 ft.).

C. orthostichum Lund.

*var. *pumilum* Lund. (Desm. Suec., p. 25, t. ii. f. 10).

Long. 25 μ ; lat. 20 μ ; lat. isthm. 5 μ ; crass. 12.5 μ .
Bo., H.

C. Botrytis (Bory) Menegh. Very frequent.

C. Turpinii Bréb. var. *Lundellii* Gutw. Near Cockermouth.

C. VEXATUM sp. n. Fig. 33.

C. mediocre, paullo longius quam latius, profunde constrictum, sinu lineari extremo ampliato; semicellulæ subtrapezicæ, lateribus convexis, angulis inferioribus rotundatis et minute undulatis, angulos superiores versus cum undulis majoribus, dorso truncato et levissime subundulato; a vertice visæ oblongo-ellipticæ, medio glabro tumidæ; a latere visæ subcirculares; membrana grosse granulata, granulis subconcentrice et subradiatim ordinatis, glabra ad medium; pyrenoidibus binis.

Long. 41-43 μ ; lat. 36-38 μ ; lat. isthm. 13.5-14 μ ; crass. 20-21 μ . Ambleside, not uncommon.

At first sight this appears like some forms of *C. Botrytis* (Bory) Menegh., but it is much smaller, it has truncate and almost smooth apices, the lateral undulations are larger towards the apex as in *C. Quasillus* Lund., and the vertical view has a *glabrous inflated centre*. It differs from *C. Quasillus* Lund. and *C. subquasillus* Boldt in its smaller size and in the smaller central inflation of the vertical view being without undulations, as well as in other particulars. It

is quite distinct from *C. præmorsum* Bréb. (see Nordst. Norges Desm., tab. i. fig. 1), and *C. formosulum* Hoff.

C. præmorsum Bréb. B., near Windermere, Crummock Water, Embleton, near Cockermouth, Blea Tarn in Borrowdale.

C. Broomei Thwaites. L., Crummock Water.

C. ochthodes Nordst. Frequent. Occurs up to 2400 ft. on Helvellyn.

var. AMŒBUM var. n. Fig. 31.

Var. semicellulis subtruncatis, verrucis depressis irregularibus et sinuatis angulis 3-5.

Long. 87 μ ; lat. 60 μ ; lat. isthm. 21 μ ; crass. 40 μ . Bn., Hk. Frequent.

C. confusum Cooke var. *regularius* Nordst. Hp., Bn.
subsp. *ambiguum* West. Hk., Bt.

C. amœnum Bréb. H.

C. cylindricum Ralfs. H.

C. SUBCYLINDRICUM sp. n. Fig. 22.

C. submediocre, diametro $1\frac{3}{4}$ -plo longius quam latius, leviter constrictum; semicellulæ semi-ellipticæ cum lateribus subrectis, irregulariter et dense granulosa, cum annulo granulorum majorum ad basem; a vertice visæ circulares.

Long. 37 μ ; lat. 21 μ ; lat. isthm. 18 μ . L.

It differs from *C. cylindricum* Ralfs in the semicells not being subquadrate, in being wider towards the base, in the rounded ends, in the granules not being arranged in lines, and in the basal ring of larger granules.

C. annulatum (Näg.) De Bary.

var. *elegans* Nordst.

Long. 46-52 μ ; lat. 17-18 μ . Hk., Bt., Bo., Pike of Bliscoe.

C. subcostatum Nordst. Bo., Esthwaite Water.

C. subprotumidum Nordst. B.

C. Bæckii Wille. H., B., W., near Cockermouth.

C. sphaerostichum Nordst. Bo., H., Sk., Bt., C., Blea Tarn in Borrowdale.

C. cælatum Ralfs. Very frequent.

C. ornatum Ralfs. B., H., W., Hp., near Cockermouth.

C. quinarium Lund. B., Bn.

C. cyclicum Lund. Bo., H.

var. *angulatum* West, Freshw. Alg. of N. Yorks. in Journ. Bot., Oct. 1889, t. 291, f. 2. [*C. Nordstedtii* Reinsch., Contrib. Alg. et Fung., t. 10, f. 11.]

Long. 48 μ ; lat. 54 μ ; lat. isthm. 19 μ ; crass. 23 μ .
Fig. 19. Bo.

C. speciosum Lund.

*var. *biforme* Nordst. Kirk Fell.

C. subspeciosum Nordst. H.

**C. supraspeciosum* Wolle.

var. EMARGINATUM var. n. Fig. 24.

Var. minor, crenis distincte emarginatis, sinu extremo ampliato. Pyrenoidibus binis.

Long. 61 μ ; lat. 52 μ ; lat. isthm. 18 μ . B.

C. isthmiunum West. L.

C. moniliforme (Turp.) Ralfs. B., Crummock Water, Ennerdale.

*forma *panduriformis* Heimerl (Desmidiaceæ Alpinae, p. 12, tab. v. f. 11). B.

C. contractum Kirchn. Bn.

C. globosum Buln. Sk., near Cockermonth.

C. MORSUM sp. n. Fig. 10.

C. mediocre, diametro circiter duplo longius, leviter contractum, incisura mediana semicirculari; semicellulæ semiellipticæ, angulis inferioribus subacutis; a vertice visæ latissime ellipticæ; a latere visæ subcirculares lateribus subcompressis; membrana lævis.

Long. 40·5 μ ; lat. 23·2 μ ; lat. isthm. 15·5 μ ; crass. 20·2 μ . Bn.

C. connatum Bréb. Bo., C., Hk., Bassenthwaite Water.

var. *truncatum* West. Hk.

C. pseudconnatum Nordst. L.

C. viride (Corda) Joshua. Ennerdale.

C. pseudarctoum Nordst. Fig. 16. Hk., W., H., L., Pike of Bliscoe.

C. cucurbita Bréb. Common.

Forma major et latior.

Long. 42 μ ; lat. 27 μ . L., Grisedale Tarn, Kirk Fell, Brandreth.

C. palangula Bréb.

var. *De Baryi* Rabh. Hk.

C. obcuneatum West.

Forma minor latior lateribus leviter concavis. Membrana lævis.

Long. 30 μ ; lat. 16–17 μ ; lat. isthm. 13–14 μ . Fig. 8. H., Bn., L., Grisedale Tarn, Pike of Bliscoe.

C. Thwaitesii Ralfs. H., S.

C. turgidum Bréb. Hk.

var. SUBROTUNDUM var. n.

Var. duplo longius quam latius; semicellulis subrotundis.

Long. 140 μ ; lat. 77 μ ; lat. isthm. 60 μ . Bn.

C. Ralfsii Bréb. Sk., Hk., Brandreth, Grisedale Tarn.

C. Cucumis Corda. Very frequent. Occurs up to 2400 ft. on Helvellyn.

forma *major* Nordst. H. (at 2400 ft.).

C. De Baryi Arch. B., S., L.

C. elegantissimum Lund.

forma *minor* West. Bo., Bn., H., C.

Genus *Xanthidium* Ehrnb. ; Ralfs.

X. armatum Bréb. W., Hk., Kirk Fell.

X. aculeatum Ehrnb. B., Bn., C., H. (at 2400 ft.), Deepdale,
Black Sail Pass.

X. Brébissonii Ralfs. B., Deepdale.

var. *varians* Ralfs. D epdale.

X. antilopæum (Bréb.) Kütz. H., B, S., C., Hk., Bassenthwaite
Water.

X. cristatum Bréb. Hk.

var. *uncinatum* Bréb. Hk.

Genus *Arthrodesmus* Ehrnb. ; Arch.

A. octocornis Ehrnb. Hp., Sk., L.

A. Incus (Bréb.) Hass. W., B., R., C., Hp. (cum zygosp.),
Ennerdale.

Diam. zygosp. s. spin. 20 μ ; c. spin. 34 μ .

var. *intermedius* Wittr. Sk., Hk.

A. Ralfsii West. Bn.

A. convergens Ehrnb. Bo., R., Hk., Bassenthwaite Water.

A. bifidus Bréb.

var. *truncatus* West. Bn.

A. glaucescens Wittr.

forma *convexa* West. Hk., W. (cum zygosp).

Zygosporeæ globosæ, aculeis simplicibus longis ornatae.

Diam. zygosp. s. spin. 16.5 μ ; c. spin. 29 μ . Fig. 27.

Gen. *Staurastrum* Meyen ; Ralfs.

S. dejectum Bréb. S., B., Ennerdale.

Forma 4-gona. Bo., S., Hk.

var. *patens* Nord. B.

S. apiculatum Bréb. L., Bassenthwaite Water.

S. mucronatum Ralfs. W.

S. Dickiei Ralfs. S., R., B., Hk.

forma *punctata* West. Bn.

S. brevispinum Bréb., Bn., Hk.

S. cuspidatum Bréb. R., B., H., Sk.

var. *maximum* West. B.

S. aristiferum Ralfs. B.

S. O'Mearii Arch. S., Sk.

S. megacanthum Lund. W.

S. lunatum Ralfs. B., Buttermere.

S. cristatum (Näg.) Arch. Hk., not uncommon.

S. avicula Bréb. B.

- S. fureatum* (Ehrnb.) Bréb. S., L.
 var. *armigerum* (Bréb.) Rabh. W., C., Hk.
- **S. senarium* (Ehrnb.) Ralfs. Bn.
- S. Reinschii* Roy. Sk., Hk.
- S. hirsutum* (Ehrnb.) Bréb. W., B., H., Bt., C., Hk., Blea Tarn in Borrowdale.
- S. pilosum* (Näg.) Arch. Bn., C., Bo., Hk., Wythburn, Black Sail Pass.
- S. Brebissonii* Arch. var. BREVISPINUM var. n. Fig. 26.
 Var. *spinis brevioribus et validioribus*.
 Long. 49 μ ; lat. s. spin. 42.5 μ ; lat. c. spin. 45 μ ;
 lat. isthm. 17.5 μ . B.
- S. Hystrix* Ralfs. B.
- S. teliferum* Ralfs. Frequent.
- S. polytrichum* (Perty) Rabh. Bn.
- S. asperum* Bréb. C.
- S. muticum* Bréb. S., Kirk Fell.
- S. orbiculare* (Ehrnb.) Ralfs. Common.
 forma *major*.
 Long 61 μ ; lat. 50 μ ; lat. isthm. 17.5 μ . Bo.
 *var. *extensum* Nordst. A small form.
 Long. 38–39 μ ; lat. 25.5–28 μ ; lat. isthm. 8–10 μ .
 R., Lake Side, Sty Head Tarn.
 var. *depressum* Roy. et Biss. Bn., Hk.
- S. Bieneanum* Rabh. B.
- S. Hibernicum* West.
 Forma membrana irregulariter punctata.
 Long. 63 μ ; lat. 56 μ ; lat. isth. 19.5 μ . L.
- S. ELLIPTICUM sp. n. Fig. 28.
 S. mediocre, circiter 1½-plo longius quam latus, modice constrictum, sinu acutangulo et ampliato; semicellulæ ellipticæ; a vertice visæ trigonæ lateribus leviter convexis, angulis late rotundatis; membrana lævis; pyrenoidibus singulis magnis.
 Long. 42.5–46 μ ; lat. 29–30 μ ; lat. isthm. 13–15 μ . Bo.

The front view is similar in form to *S. turgescens* De Not., but the membrane is smooth and the vertical view is different. It differs from *S. vesiculatum* Wolle (Freshw. Alg. of U.S., p. 42, pl. liv. f. 6, 7) in its broader sinus and elliptical semicells.

- S. Kjellmani* Wille. Sk., H., Bt., Blea Tarn in Borrowdale.
- S. pygmæum* Bréb. Frequent.
- S. turgescens* De Not. Trough at Ambleside, Buttermere, Blea Tarn in Borrowdale.
- S. muricatum* Bréb. Bo., B., Hp., Kirk Fell.

A form of this species occurred at an elevation of 2400 ft. on Helvellyn, which was just as long as broad, and very similar to figs. 19 and 20, tab. vi. in Nordst., Desmidieer från Bornholm.

- S. pyramidatum* West. Bn., H.
S. punctulatum Bréb. Common. Zygosporae from Lake Side.
S. amœnum Hilse. Sk., Scawfell, Easedale.
S. Meriani Reinsch. H., Bt., C., Blea Tarn in Borrowdale.
S. alternans Bréb. B., S., W., Bassenthwaite Water.
S. dilatatum Ehrnb. B., Bo., Hk., H. (at 2400 ft.), Crummock Water.
S. quadrangulare Bréb.
 Long. 25 μ ; lat. s. spin. 25 μ , c. spin. 32 μ ; lat. isthm. 8 μ . L.
S. tumidum Bréb., S., C.
S. grande Buln. Bo., Bn. L.
S. tricornis (Bréb.) Menegh. Frequent.
S. cyrtocentrum Bréb. f. 3-gona. B., W., Deepdale.
 f. 4-gona. Bn.
S. arcuatum Nordst. Brandreth.
 subsp. SUBAVICULA subsp. n. Fig. 25.
 Semicellulæ a fronte et a vertice visæ ut in *S. avicula*, cum processibus bifurcatis radiantibus sex ad apicem.
 Long. s. proc. 29 μ ; lat. 32.5 μ ; lat. isthm. 9.5 μ . Hp.
S. inflexum Bréb. B.
S. polymorphum Bréb. W., Hp., Bt., Deepdale, near Ambleside.
 var. MUNITUM var. n. Fig. 35.
 Var. processibus seriebus transversis spinularum munitis; semicellulæ a vertice visæ triangulares lateribus rectis.
 Long. 31 μ ; lat. c. proc. 36 μ . Esthwaite Water, not uncommon.
S. gracile Ralfs. W., Hp., C.
 var. nanum Wille. Hp.
 *var. coronulatum Boldt (Siber. Chlor., taf. v. fig. 28).
 Forma trigona; corona verrucis emarginatis sex.
 Long. 21 μ ; lat. 32.5 μ ; lat. isthm. 6 μ . Fig. 36. Bn.
S. paradoxum Meyen. B., Hp., Crummock Water.
S. controversum Bréb. Hk., Buttermere.
S. aculeatum (Ehrnb.) Menegh. W., L., Hk.
S. vestitum Ralfs. L., Hk., Deepdale.
 var. SEMIVESTITUM var. n. Fig. 38.
 S. minor quam forma typica; semicellulæ apicibus subrectis; a vertice visæ triradiatæ processibus curvatis trifurcatis (ut in *S. cyrtocero*), cum spina furcata una ad basem lateris convexi processus uniuscujusque.
 Long. c. spin. 21–28 μ ; lat. 34.5–42 μ ; lat. isthm. 4.5–8 μ . L., Brandreth.
S. oxyacanthum Arch. L.
S. Sebaldi Reinsch. Bn.

S. Pseudosebaldi Wille var. *SIMPLICIUS* var. n. Fig. 37.

Var. *minor*, spinis aculeatis—nec bifurcatis—dorso, apicibus processuum breviorum longius tricuspidatis.

Long. c. spin. 32 μ ; lat. 46 μ ; lat. isthm. 9 μ .
Brandreth.

S. eustephanum (Ehrnb.) Ralfs. Bn., L.

S. furcigerum Bréb. B., L.

S. seæcostatum Bréb. B.

subsp. *PRODUCTUM* subsp. n. Fig. 34.

S. circiter tam longum quam latum (cum processibus); semicellulæ processibus brevibus sex (*non* lobis), cum apicibus processuum truncatis et sexdentatis, cum annulo granulorum aculeatorum ad basem semicellularum; apices verrucis emarginatis irregulariter dispersis ornati; a vertice sexradiatis, radiis semicellulæ utriusque alternantibus.

Long. 40–43 μ ; lat. 43 μ ; lat. isthm. 16–17 μ . Bn.,
B., H. (at 2400 ft.).

S. margaritaceum (Ehrnb.) Menegh. Very frequent.

Forma cum annulo punctorum (circiter 14) ad basem semicellularum.

Long. 32 μ ; lat. 30 μ ; lat. isthm. 10·5 μ . Hp., Grey
Knotts.

S. tetracerum (Kütz.) Ralfs. W., R., B.

Class MULTINUCLEATÆ.

Order SIPHONÆÆ.

Genus *Vaucheria* D. C.

V. sessilis (Vauch.) D. C. Bn.

Class CÆNOBIEÆ.

Order VOLVOCINEÆ.

Genus *Eudorina* Ehrnb.

E. elegans Ehrnb. Bn., L.

Order PANDORINEÆ.

Genus *Pandorina* (Bory) Prings.

P. morum Müll. H., Bn., R., Crummock Water.

Genus *Gonium* (Müll.) Ehrnb.

G. pectorale Müll. B.

Genus *Chlamydococcus* A. Br.

C. pluvialis A. Br. Deepdale.

Order PEDIASTREÆ.

Genus *Pediastrum* Meyen.

P. angulosum (Ehrnb.) Menegh. R., Bn., Crummock Water.

P. Boryanum (Turp.) Menegh. Frequent.

var. *granulatum* (Kütz.) A. Br. W., Bn., R., near
Cockermouth.

P. duplex Meyen (*P. pertusum* Kütz.) B., Bn.

P. Tetras (Ehrnb.) Ralfs. Bn.

**P. tricornutum* Borge (Chloroph. från Norska Finmarken,
p. 4, f. 3). W.

P. integrum Näg. Bn., L.

Order SORASTREÆ.

Genus *Selenastrum* Reinsch.

**S. acuminatum* Lagerh. in Wittr. et Nordst., Alg. exsic., fasc. 9,
No. 441; Bidrag till känn. om Stockholms Pediastr., Protococc., och
Palmell., p. 71, t. iii. f. 27-30. Bn.

S. OBESUM sp. n. Figs. 50-52.

*S. cellulis obesis arcuatissimis, apicibus obtusis subacu-
tise; familiis e cellulis 4-8 constitutis, facile dissociatis;
apicibus cellularum adularum 1.5-2 μ inter se distantibus;
contentum cellularum læte viride, granulatum.*

Crass. cell. 3-4.2 μ ; diam. max. 6-9 μ . Bn.

The form of the cells of this species at once distinguishes it from
any other, the cells being bent until their apices almost meet. This
sometimes occurred in masses containing from 4 to 24 groups, each
consisting of 4-8 cells.

Genus *Sorastrum* Kütz.

S. spinulosum (Kütz.) Näg. Bn., Crummock Water.

Genus *Staurogenia* Kütz.

S. rectangularis (Näg.) A. Br. Kirk Fell, Brandreth.

Genus *Cœlastrum* Näg.

C. sphaericum Näg. Fig. 64. Bn., B., Hk., L.

C. cambricum Arch. Bn., C.

C. cubicum Näg. Bn.

C. microporum Näg. R.

PROTOPHYTA.

Group SCHIZOPHYCEÆ.

Class PROTOCOCCOIDEÆ.

Order EREMOBIEÆ.

Genus *Hormospora* Bréb.

**H. plena* Bréb. (Rabh. Fl. Eur. Alg., p. 48). Bn.

Genus *Cylindrocapsa* Reinsch.

C. CONFERTA sp. n. Figs. 40-42.

C. cellulis indivisis quadrato-ellipsoidicis, fere latius quam longius, confertis, cum tegumentis hyalinis circiter binis circumvelatis.

Lat. cell. 21-26 μ ; long. cell. 12-20 μ ; diam. tubul. 24-30 μ . Bn.

The cells had very firm walls and were filled with intensely green granulose contents. The crowded subangular cells seem to distinguish this from any other species hitherto described.

Genus *Sciadium* A. Br.

S. arbuscula A. Br. Bn., Crummock Water.

Genus *Ophiocytium* Næg.

O. cochleare (Eich.) A. Br. B., Bn., R., Hk., Crummock Water.

**O. majus* Næg. Bn.

Genus *Dictyosphærium* Næg.

D. Ehrenbergianum Næg. Bn., Angle Tarn, Crummock Water.

D. reniforme Buln. Bn.

Genus *Dimorphococcus* A. Br.

D. lunatus A. Br. Long. cell. 12-17.5 μ ; crass. cell. 6.5-7.5 μ . Fig. 39. Bn. *Scenedesmus radiatus* Reinsch (Algenfl. des Mitt. von Frank., p. 81, t. vi. f. vi.) is probably a smaller form of this species, with more rounded apices.

Genus TETRACOCCLUS gen. n.

Cellulæ parvæ, globosæ vel subglobosæ (nonnumquam subangulares), virides, regulariter quaternæ et propinquæ, familias parvas irregulares, libere natantes, formantes, cellularum 20-80; subfamilia singula quaterna filis delicatis hyalinis subcurvatis sublaxe conjuncta, non-radiatim (forsan reliquæ membranarum cellularum seniorum); contentum chlorophyllosum cellularum cum granulis magnis paucis; propagatio cellularum divisione planitie in duas directiones alternans, et atque fit cellulis filialibus quattuor in cellula matricali ortis.

T. BOTRYOIDES sp. n. Figs. 43-48.

Character idem ac generis.

Diam. cell. 3.8-5.7 μ ; diam. famil. 30-57 μ . Bn., not unfrequent.

The nearest genus to this is *Dimorphococcus* A. Br., but this genus has its quaternate cells of two forms, which character gives rise to the generic name, and the four cells composing these dimorphic groups are somewhat irregularly joined together by short, broad, hyaline processes; these characters do not apply to *Tetracoccus*.

It is also sufficiently distinct from the genera *Dictyosphærium* Näg., *Dictyocystis* Lagerh., and *Botryococcus* Kütz.

Genus *Apiocystis* Näg.

A. Brauniana Näg. B., Bn.

Genus *Hydrionum* Reinsch.

H. heteromorphum Reinsch. W. Sk., Angle Tarn.

Genus *Characium* A. Br.

C. Sieboldii A. Br. Near Cockermouth.

C. ornithocephalum A. Br. Bn.

Genus *Dactylococcus* Näg.

**D. infusionum* Näg. Gatt. ein. Alg., p. 85, t. iii. Bn.

D. De Baryanus Reinsch. Attached to *Cyclops*, Bowness.

Genus *Nephrocystium* Näg.

N. Nägelii Grun. R.

N. LUNATUM sp. n. Fig. 49.

N. cellulis lunatis et attenuatis, apicibus subobtusis, diametro 3-4½-plo longioribus, dorso valde convexo, ventre leviter concavo; familiis e cellulis 4 vel 8 formatis, subspiraliter ordinatis; tegumento hyalino, diametro duplo longioribus; contentum cellularum pallidum viride, granulatum.

Long. cell. 14-18 μ ; lat. cell. 4-6 μ ; long. tegument. 36-60 μ ; lat. teg. 20-32 μ . Bn., R.

This is a very characteristic species, being abundantly distinct from the other species.

Genus *Oocystis* Näg.

O. Nägelii A. Br. H., near Windermere.

O. solitaria Wittr. Hp., Sk., Hk., L.

**O. crassa* Wittr.

Long. cell. 14·5-15·5 μ ; lat. 10-10·5 μ . B.

**O. Novæ Semliæ* Wille.

forma major Wille. Bo.

O. ELLIPTICA sp. n. Fig. 56.

O. cellulis in familias e 4-8 cellulis formantes consociatis, cellulis oblongo-ellipticis, 2¼-plo longius quam latius, apicibus rotundatis et non-incrassatis.

Long. cell. 24-25 μ ; lat. cell. 11-11·5 μ . Bt.

forma minor.

Long. cell. 15-17 μ ; lat. 7·5-8 μ . Buttermere.

This seems distinct from *O. Novæ Semliæ* Wille, *O. solitaria* Wittr., &c.

Order PROTOCOCCACEÆ (includ. PALMELLACEÆ).

Genus *Pleurococcus* Menegh.

P. angulosus Menegh. S.

Genus *Trochiscia* Kütz.

T. aciculifera (Lagerh.) Hansg.

Diam. s. spin. 20 μ , c. spin. 28 μ . Bn.

T. UNCINATA sp. n. Fig. 54.

T. cellulis parvis globosis, solitariis vel in familiis parvis aggregatis; membrana cellularum tenui, spinis longis curvatis validissimis ornata; contentum chlorophyllosum granulosum cellularum læte viride.

Diam. cell. s. spin. 12·5–13·5 μ ; c. spin. 21–23 μ . Bn.

Genus *Palmella* (Lyngb.) Näg.

P. mucosa Kütz. H.

P. hyalina Bréb. R.

Genus *Botrydina* Bréb.

B. vulgaris Bréb. S.

Genus *Palmodictyon* Kütz.

P. viride Kütz. Crummock Water.

Genus *Tetraspora* Link.

T. bullosa (Roth) Ag. Lake Side.

Genus *Chlorococcum* Fries.

C. gigas (Kütz.) Grun. Bn., B., R., Hp.

C. REGULARE sp. n. Fig. 55.

C. cellulis subrotundatis, singulis, geminatis (rarius ternis), quaternis, vel octonis consociatis; membrana cellularum subcrassa; dispositione chromatophorarum parietali cum puncto rubro unaquaque cellula; tegumento hyalino pellucidissimo et non-lamellosa.

Diam. cell. s. teg. 12–15·5 μ , c. teg. 36–48 μ .

Hab. amongst *Sphagnum* and *Utricularia*, frequent. Harrop Tarn and Bowness. Also seen from East Cornwall, Devonshire, North and West Ireland.

It differs from *C. gigas* (Kütz.) Grun. in its very hyaline tegument not being lamellose, in its thicker cell-walls and in the cells being arranged usually in a binate or quaternate manner.

Genus *Glæocystis* Näg.

G. ampla (Kütz.) Rabh. H., R., Bn.

G. vesiculosa Näg. Frequent.

Genus *Schizochlamys* A. Br.*S. gelatinosa* A. Br.Diam. cell. 10–12 μ . S., Sk., L.*S. DELICATULA* sp. n. Fig. 57.

S. cellulis parvis, globosis subglobosisve, vel singulis vel geminis in familias consociatis; familiæ 10–50 in matricem hyalinam achroam aggregatæ; membrana tenuis dissociata in unam portionem; divisio cellularum in unam directionem fit.

Diam. cell. 5·8–6·7 μ . Bo., Bn., Esthwaite Water.

This is a much smaller and more delicate plant than *S. gelatinosa* A. Br., the much thinner membrane separating in one piece, the new cell escaping by a lateral slit, and the division of the cells is only in one direction.

Genus *Eremosphæra* De Bary.*E. viridis* De Bary. Frequent. Occurs up to 2400 ft. on Helvellyn.Genus *Botryococcus* Kütz.*B. Braunii* Kütz. B., Bn., Black Sail Pass, near Cockermouth.*B. calcareus* West. Bn.Genus *Urococcus* Hass.*U. insignis* (Hass.) Kütz. Very frequent.Genus *Rhaphidium* Kütz.*R. polymorphum* Fres. var. *fulcatum* (Corda) Rabh. Very frequent.var. *aciculare* (A. Br.) Rabh. Bn.**R. convolutum* (Corda) Rabh. Bo.*R. bplex* Reinsch. Bn.Genus *Scenedesmus* Meyen.*S. bijugatus* (Turp.) Kütz. Near Cockermouth, Bassenthwaite Water.*S. alternans* Reinsch. Bo., Bn.*S. denticulatus* Lagerh.var. *linearis* Hansg. (var. *lineatus* West). Bn., Hk.*S. quadricauda* (Turp.) Bréb. Frequent.*S. antennatus* Bréb. Bn., Rydal Water.*S. acutus* Meyen. Frequent.var. *obliquus* (Turp.) Rabh. Bn., near Cockermouth.var. *dimorphus* (Kütz.) Rabh. Bn.Genus *Tetraëdron* Kütz.*T. minimum* (A. Br.) Hansg.Lat. cell. 10 μ ; crass. 6 μ . Angle Tarn.**T. trigonum* (Näg.) Hansg. Bn.

T. regulare Kütz. (*Polyedrium tetraëdricum* Næg.). Bn.

forma PACHYDERMA.

Forma membrana crassissima.

Lat. 31–35 μ ; crass. membr. 2–2.5 μ . Bn.

T. gigas (Wittr.) Hansg.

forma OBTUSA.

Forma angulis abrupte obtusis.

Lat. 27–42 μ . Kirk Fell.

var. MAMILLATA var. n. Fig. 53.

Var. major, angulis mamillatis.

Lat. max. 92 μ . Bn.

T. enorme (Ralfs.) Hansg. R., Bn.

Class PHYCOCHROMACEÆ.

Sub-class *Nostochineæ*.

Order NOSTOCACEÆ.

Genus *Nostoc* Vauch.

**N. paludosum* Kütz. Bn.

N. muscorum Ag. Amongst mosses, Scandale.

N. humifusum Carm. R.

N. microscopicum Carm. [*N. rupestre* Kütz. *N. hyalinum* Benn. (*N. opalinum* Benn.)]. Bn., R., H., Bt., Deepdale.

Genus *Anabæna* Bory.

A. sp. Crass. cell. 7.5–8 μ ; crass. heterocyst. 8.5–9 μ . Bn.

Order RIVULARIACEÆ.

Genus *Dichothrix* Zanardini.

D. Orsiniana (Kütz.) Bornet et Flah. (Revis. des Nostocac. Hétérocyst., p. 376). Langdale.

Genus *Glæotrichia* J. Ag.

G. Pisum (Ag.) Thuret. Pike of Bliscoe.

Order SCYTONEMACEÆ.

Genus *Microchæte* Thur.

**M. diplosiphon* Gomont var. CUMBRICA var. n.

Var. cum articulis prope basem 7.5–8 μ crassis, apicem versus 3 μ crassis; vagina exteriore 23–30 μ crassa; heterocystis intercalaribus diametro 4-plo longioribus.

Crass. vag. inter. 6.5–9 μ ; long. heterocyst. intercal. 22–24 μ , lat. 5.5 μ . C.

No freshwater species of this genus has hitherto been recorded for Britain. The form seen had the trichomes occasionally interrupted.

Genus *Scytonema* Ag.

S. COOKEI sp. n.

[*S. natans* Cooke (Brit. Freshw. Alg., p. 265, pl. 105, fig. 2) non Bréb.].Crass. fil. 18–24 μ ; crass. trich. 6–7 μ . Langdale.

This species belongs to the section *Euscytonema* Bornet et Flah. (Revis. des Nostocac. Hétérocyst., p. 86); it has the sheath composed of parallel strata and has distinct dissepiments. *S. natans* Bréb. does not belong to this genus, it is the same as *Plectonema mirabile* Thur. (vide Bornet et Flah., l.c. p. 113). As Cooke's description of the species which he places under *S. natans* Bréb. agrees with the Langdale plant, I propose to call it *S. Cookei*.

S. figuratum Ag. H., C., Pike of Bliscoe.*S. crustaceum* Ag. [*Petronema fruticulosum* Thwaites.] Bo.Genus *Tolypothrix* Kütz.

T. tenuis Kütz. [*T. pygmea* Kütz.; *T. flaccida* De Bary.] Bn., H., Hk., Crummock Water.

Genus *Desmonema* Berk. et Thwaites.*D. Wrangelii* (Ag.) Bornet et Flah. (Revis. des Nostocac. Hétérocyst., p. 127).[*Calothrix Dillwynii* Kütz.; *Desmonema Dillwynii* Berk. et Thw.]

var. MINOR var. n.

Var. trichomatibus angustioribus. Lat. trich. 5–6 μ .
Langdale.

Exactly similar to the typical form but smaller.

Order SIROSIPHONACEÆ.

Genus *Stigonema* Ag.*S. ocellatum* (Dillw.) Thur. R.*S. panniforme* (Ag.) Bornet et Flah. Pike of Bliscoe.*S. minutum* (Ag.) Hass. Bo.*S. turfaceum* (Eng. Bot.) Cooke. Bt., Langdale.*S. mamillosum* (Lyngb.) Ag. Langdale.

Order OSCILLARIACEÆ.

Genus *Oscillaria* Bosc.*O. tenerrima* Kütz. Near Keswick, near Cockermouth.*O. leptotricha* Kütz. Bassenthwaite Water, near Cockermouth.*O. subfusca* Vauch. Bn.*O. tenuis* Ag. H., Bn., Sk., C.*O. limosa* (Roth) Ag. Bo., Vale of Newlands.*O. nigra* Vauch. H., Bn.*O. Frolichii* Kütz. Bn.*O. princeps* Vauch. Bn., C., Hk.

Genus *Lyngbya* Ag.

L. SUBTILE sp. n. Fig. 58.

L. solitaria et *sparsa*, trichomatibus subflexuosis, libere natantibus, distincte articulatis; vaginis arectis, achrois; articulis diametro duplo; cytoplasmate pallide ærugineo et homogeneo.

Lat. fil. 1.5–1.8 μ . Bo., H., Bn., Scarf Gap Pass.

This is one of the smallest species of the genus yet observed. The filaments are frequently interrupted in the sheath and single joints occasionally become separate, as well as parts of the filament. It is sufficiently distinct from *L. hyalina* Borzi (Nuova Notarisia, Apr. 1892, p. 40) which occurs in an olive-green stratum and has tortuose and intricate filaments, and its cells longer than broad.

L. vulgaris (Kütz.) Kirch. H. (at 2400 ft.).

Genus *Inactis* Kütz.

I. tinctoria (A. Br.) Thur. On *Myriophyllum* in Crummock Water.

Genus *Spirulina* Link.

S. oscillarioides Turp. B., Bn.

var. *minutissima* (Hass.) Rabh. Forma anfractibus laxissimis, 1 in 38 μ . Crass. trich. 2 μ . Bn.

Sub-class *Chroococcaceæ*.

Order CHROOCOCCACEÆ.

Genus *Chroococcus* Näg.

**C. minor* (Kütz.) Näg. (Gatt. einz. Alg., p. 47, t. i. A, f. 4).

H., Bt., S., L., Ennerdale, near Bow Fell.

**C. pallidus* Näg. (l.c. p. 46, t. 1 A, f. 2). Sk., C.

C. coherens (Bréb.) Näg. L., Sk., Bn.

C. turgidus (Kütz.) Näg. Frequent.

var. VIOLACEUS var. n.

Var. cytoplasmate constanter violaceo.

Diam. cell. s. teg. 14–18 μ ; c. teg. 18–22 μ .

Foot of Bow Fell, near Angle Tarn, along with

Aphanothece saxicola Näg. and *Glæocapsa quaternata* (Bréb.) Kütz.

C. GIGANTEUS sp. n. Figs. 59 and 60.

C. cellulis magnis subsemicircularibus, plerumque binis (rarius quaternis) in familias consociatis; familiis solitariis; tegumento hyalino, leve lamelloso (lamellis 2–3); cytodermate tenui; cytoplasmate densissime æruginoso et granulato.

Diam. cell. s. teg. 54–58 μ ; c. teg. 67–70 μ ; crass. teg. 5.4–6 μ . Bn., not uncommon.

This differs from *C. turgidus* (Kütz.) Näg. in its very much larger cells with relatively much thinner tegument.

C. SCHIZODERMATICUS sp. n. Figs. 61-63.

C. cellulis subglobosis vel subtrigonis, nonnunquam subreniformibus, binis vel ternis, quaternis in familiis consociatis; familiis solitariis vel 2-4 aggregatis; tegumento crassissimo, stramineo vel fusciscente, valde lamelloso (lamellis 5-10), demum irregulariter discedente; cytiodermate subcrasso; cytioplasmate æruginoso et granulato.

Diam. transv. cell. s. teg. 5·8-11 μ , c. teg. 21-38 μ ; diam. long. cell. s. teg. 5-7·6 μ , c. teg. 27-42 μ . Near Windermere.

This is at once distinguished from all other species by the peculiar thick, splitting tegument similar to that of *Urococcus insignis* (Hass.) Kütz. (*Chroococcus macrococcus* Rabh. et var. *aureus* Rabh.).

Genus *Glæocapsa* Näg.

G. atrata Kütz. Langdale.

G. caldariorum Rabh. H.

G. polydermatica Kütz. Sk., near Windermere.

G. quaternata (Bréb.) Kütz. Bow Fell, near Angle Tarn.

G. æruginosa (Carm.) Kütz. Langdale.

**G. punctata* Näg. (Gatt. einz. Alg., t. i. F, f. 6).

Diam. cell. s. teg. 0·8-1 μ . Langdale.

Genus *Aphanocapsa* Näg.

**A. pulchra* (Kütz.) Rabh. (Fl. Eur. Alg., ii. p. 49).

Diam. cell. 2·5-3 μ . Bn.

A. Grevillei (Berk.) Rabh. R., Bn., S.

Genus *Microcystis* Kütz.

M. protogenita (Bias.) Rabh. Bn., near Cockermouth, Esthwaite Water.

M. marginata (Menegh.) Kirchn. Bn.

Genus *Clathrocystis* Henfrey.

C. æruginosa (Kütz.) Henfrey. Bn.

Genus *Cælosphærium* Näg.

C. Kützingianum Näg. Bn.

Genus *Merismopedia* Meyen.

M. glauca (Ehrnb.) Näg. Very frequent.

M. æruginosa Bréb. Bn.

M. irregulare Lagerh. Hp.

Genus *Synechococcus* Näg.

S. æruginosus Näg. H., Langdale.

S. crassus Arch. Bn., Kirk Fell.

Genus *Glæotheece* Näg.

**G. linearis* Näg. (Gatt. eing. Alg., p. 58, t. i. G, f. 2). Hk, L.

**G. violacea* Rabh. (Fl. Eur. Alg., ii. p. 61).

Diam. cell. s. teg. 0·6–0·9 μ , c. teg. 6–9 μ . Sk.

The teguments were highly refractive.

G. cystifera (Hass.) Rabh. var. MAXIMA var. n.

Cellula latitudine $1\frac{1}{2}$ -plo longior, duplo major quam in forma typica, cytioplasmate granuloso.

Long. cell. s. teg. 14–16 μ , c. teg. 18–30 μ ; lat. cell. s. teg. 9–10 μ , c. teg. 13–20 μ . Bn.

Genus *Aphanotheece* Näg.

A. microscopica Näg. Bn., R., Scarf Gap Pass.

A. saxicola Näg. Bn., Bt., Esthwaite Water, foot of Bow Fell, near Angle Tarn.

Genus *Glaucozystis* Itz.

G. Nostochinearum Itz. Bo.

Genus *Tetrapedia* Reinsch.

T. Reinschiana Arch. Bn., Esthwaite Water.

CLASS DIATOMACEÆ.

Genus *Cyclotella* Kütz.

C. operculata (Ag.) Kütz. B.

C. Kützingiana Thw. B., H. (at 2400 ft.).

Genus *Melosira* Ag.

M. varians Ag. Bo., Bn., Vale of Newlands, Crummock Water.

M. nivalis Sm. Bo., near Windermere.

Genus *Surirella* Turpin.

S. linearis Sm. Common. Occurs up to 2400 ft. on Helvellyn.
var. *constricta* (Grun.) Rabh. Hp., Bn., C., Kirk Fell.

S. biseriata (Ehrnb.) Bréb. Frequent. Occurs up to 2400 ft. on Helvellyn.

S. angusta Kütz. Bn.

S. splendida (Ehrnb.) Kütz. Bn.

S. nobilis Sm. H. (at 2400 ft.).

S. ovalis Bréb. Deepdale.

S. ovata Kütz. Near Cockermouth.

S. minuta Bréb. Bo., near Cockermouth.

S. pinnata Sm. Bn., Threlkeld, Blea Tarn in Borrowdale.

Genus *Cymatopleura* Sm.

C. Solea (Bréb.) Sm. Bo., Bn., Deepdale, Dubb's Moss.

Genus *Epithemia* Bréb.

- E. turgida* (Ehrnb.) Kütz. H., Bn., Crummock Water.
E. Westermanni (Ehrnb.) Kütz. H., C., Pike of Bliscoe.
E. Hyndmanii Sm. Bn.
E. Sorex Kütz. Bn., B.
E. gibba (Ehrnb.) Kütz. Bn., B., L., Bt., Hk.
E. ventricosa Kütz. Bt., C.
E. Zebra (Ehrnb.) Kütz. Bn., B.
E. gibberula (Ehrnb.) Kütz. var. *rupestris* (Sm.) Rabb.
(*E. rupestris* Sm.) H., C.
E. Argus (Ehrnb.) Kütz. Bn., L., Hk.
E. alpestris Sm. Bn.

Genus *Eunotia* Ehrnb.

- E. incisa* Greg. Bn., Kirk Fell, Scawfell.
E. diodon Ehrnb. H., Bn., Scawfell.
E. triodon Ehrnb. H., Deepdale.
E. tetraodon Ehrnb. H., Bn., C., Brandreth.
E. Arcus Ehrnb. Bt., Hp., B., Kirk Fell, Easedale.
E. majus Sm. H., Black Sail Pass.
E. bidens Greg. B., C., Hk.
E. gracilis Ehrnb. Very frequent. Occurs up to 2400 ft. on Helvellyn.
E. pectinalis Dillw. W., H., B., Bn., C., Wythburn, Crummock Water.
var. *undulatum* Ralfs. C., Pike of Bliscoe.

Genus *Ceratoneis* Ehrnb.

- C. Arcus* (Ehrnb.) Kütz. Crummock Water.
C. Amphioeys Rabb. W., Sk., R., Derwent Water, Bassenthwaite Water.

Genus *Cymbella* Ag.

- C. Ehrenbergii* Kütz. Bn., Hk., Bassenthwaite Water.
C. cuspidata Kütz. Bt., C., Hk., Buttermere, Threlkeld, Dubb's Moss.
C. turgida Greg. W., B., Bn., H. (at 2400 ft.).
C. gastroides Kütz. B.
C. Smithii Rabb. (*C. helvetica* Sm.). B.
C. maculata Kütz. B., Bn., near Cockermouth.
C. ventricosa Ag. B.

Genus *Cocconema* Ehrnb.

- C. lanceolatum* Ehrnb. Frequent.
C. cymbiforme (Kütz.) Ehrnb. H., B., Bn., Derwent Water.
C. Cistula Hempr. Very frequent. Occurs up to 2400 ft. on Helvellyn.
C. parvum Sm. H., B., Threlkeld, Ennerdale, Scawfell, Stye Head Tarn.

Genus *Eneyonema* Kütz.

- E. cæspitosum* Kütz. B.
E. gracile Rabh. W.

Genus *Amphora* Ehrnb.

- A. ovalis* Kütz. Bn., W., H., B., H. (at 2400 ft.), Deepdale, Crummock Water.

Genus *Cocconeis* Ehrnb.

- C. Placentula* Ehrnb. H., Bn., Derwent Water, near Cocker-mouth.
C. Thwaitesii Sm. B.

Genus *Achnantheidium* Kütz.

- A. microcephalum* Kütz. Scawfell, Stye Head Tarn.
A. lanceolatum Bréb. B., Threlkeld, Derwent Water, near Cocker-mouth.

Genus *Achnanthes* Bory.

- A. exilis* Kütz. Very common.

Genus *Denticula* Kütz.

- D. tenuis* Kütz. B.
D. obtusa Sm. B.
D. sinuata Sm. L.

Genus *Odontidium* Kütz.

- O. hiemale* (Lyngb.) Kütz. B., H. (at 2400 ft.), Derwent Water, Crummock Water, Ennerdale, Kirk Fell.
O. mesodon Kütz. Common. Occurs up to 2400 ft. on Helvellyn.
O. nutabile Sm. Frequent.
O. Harrisonii Sm. Bn.

Genus *Fragilaria* (Lyngb.) Ag.

- F. capucina* Desmaz. Bo., H., Threlkeld, Grisedale Tarn, Derwent Water, Vale of Newlands.
F. virescens Ralfs. B., Deepdale, Crummock Water.

Genus *Diatoma* D. C.

- D. vulgare* Bory. B.
D. elongatum Ag. B., Grisedale Tarn.

Genus *Synedra* Ehrnb.

- S. lunaris* Ehrnb. Common.
S. sp. B.

This was near to *S. longissima* Sm., but was straighter and narrower.

1892.

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- S. biceps* Kütz. Frequent.
S. pulchella Kütz. B., H., Kirk Fell, near Cockermouth, Derwent Water.
S. Ulna Ehrnb. H., Bn., Ambleside, Deepdale, Dubb's Moss, Bassenthwaite Water.
S. splendens Kütz. Common.
S. Acus Kütz. B., L., Threlkeld, Esthwaite Water, Styne Head Tarn.
S. delicatissima Sm. B.

Genus *Asterionella* Hass.

- A. formosa* Hass. Bo., L., H. (at 2100 ft.), Deepdale, Bassenthwaite Water.

Genus *Amphipleura* Kütz.

- A. pellucida* Kütz. Bn.

Genus *Nitzschia* Hass.

- N. Amphioxys* (Ehrnb.) Sm. H., Cockermouth.
N. constricta (Kütz.) Pritch. (*N. dubia* Sm.). Bn.
N. parvula Sm. Bn., Scawfell.
N. sigmoidea (Nitzsch.) Sm. Bn., Derwent Water.
N. curvula (Ehrnb.) Sm. Very frequent.
N. linearis (Ag.) Sm. H., Bn., B., W., Deepdale, near Cockermouth.
N. tenuis Sm. B., Bn., Crummock Water, near Cockermouth.

Genus *Nitzschiella* Rabh.

- N. acicularis* (Kütz.) Rabh. Bn.

Genus *Navicula* Bory.

- N. cuspidata* Kütz. B., Ennerdale, Crummock Water, Dubb's Moss.
N. rhomboides Ehrnb. Very frequent.
N. serians (Bréb.) Kütz. L., C., Angle Tarn, Scawfell.
N. elliptica Kütz. (*N. ovalis* Sm.). Bo., Bn., L., B., Hk., Deepdale.
N. pygmaea Kütz. (*N. minutula* Sm.). Bn.
N. limosa (Kütz.) Grun. L.
N. amphispæna Bory. Bo., Bn., C., Bassenthwaite Water.
N. sphærophora Kütz. Near Cockermouth.
N. pusilla Sm. Bo.
N. rhynchocephala Kütz. Bo., Bn., near Cockermouth, Bassenthwaite Water.
N. affinis Ehrnb. B., Bn., H. (at 2400 ft.).
N. firma Kütz. Bn., oommon. Seen with auxospores.
N. Amphirhynchus Ehrnb. Bn., C., Bassenthwaite Water, Kirk Fell.

- N. producta* Sm. W., Bn., Vale of Newlands.
N. appendiculata Kütz. B.
N. exilis (Kütz.) Grun. Frequent.
N. cryptocephala Kütz. B., H., Ambleside, Bassenthwaite and Crummock Water.
N. dicephala Ehrnb. Bn., Derwent Water.

Genus *Pinnularia* Ehrnb.

- P. nobilis* Ehrnb. H. (at 2400 ft.), Deepdale.
P. major (Kütz.) Rabh. Common. Occurs up to 2400 ft. on Helvellyn.
P. Rabenhorstii Ralfs. (*P. interrupta* Rabh.). Sk.
P. Tabellaria Ehrnb. Derwent Water.
P. gibba Ehrnb. Very frequent.
P. lata (Bréb.) Rabh. Bn., H., Bt., C., Brandreth.
P. viridis (Ehrnb.) Rabh. Very common. Occurs up to 2400 ft. on Helvellyn.
P. alpina Sm. C.
P. radiosa (Kütz.) Rabh. Frequent.
 var. *silesiaca* (Bleisch) Rabh. Bn.
P. borealis Ehrnb. B., Threlkeld.
P. acuta Sm. Bn.
P. mesolepta Sm. W., Bn., Bt., L., C.
P. divergens Sm. H., Bn., Deepdale.
P. Brebissonii (Kütz.) Rabh. Very frequent.
 var. *subcapitata* Rabh. Hp., Bt., B., L., Ennerdale.

Genus *Frustulia* Rabh.

- F. saxonica* Rabh. forma *aquatica* Rabh. (*Navicula crassinervia* Bréb.). Common.

Genus *Pleurosigma* Sm.

- P. attenuatum* (Kütz.) Sm. Threlkeld.
P. Spencerii (Quekett) Sm. Bo., near Cockermouth.

Genus *Stauroneis* Ehrnb.

- S. Phœnicenteron* (Nitzsch) Ehrnb. Very frequent.
S. gracilis Ehrnb. Bn.
S. anceps Ehrnb. B., Bn, Bt., C.
S. dilatata Sm. Bn.

Genus *Schizonema* Ag.

- S. neglectum* (Thw.) Rabh. Bassenthwaite Water.

Genus *Gomphonema* Ag.

- G. tenellum* Kütz. Frequent.
G. dichotomum Kütz. W., H., B., Kirk Fell.
G. Vibrio Ehrnb. H., Stye Head Tarn.

- G. capitatum* Ehrnb. Bn., Sk.
G. constrictum Ehrnb. Bn., near Cockermouth, Sty Head
 Tarn, Ennerdale.
G. geminatum Ag. H., R., B.
G. acuminatum Ehrnb. B., W., H., Bn., Sty Head Tarn,
 Crummock Water.
G. olivaceum (Lyngb.) Kütz. B., Bassenthwaite Water.
G. intricatum Kütz. B., L., C., Sty Head Tarn.

Genus *Meridion* Ag.

- M. circulare* (Grev.) Ag. B., Hp., near Cockermouth.

Genus *Tabellaria* Ehrnb.

- T. flocculosa* (Roth) Kütz. Very common.
 var. *ventricosa* (Kütz.) Rabh. Scawfell, Crummock
 Water.
T. fenestrata (Lyngb.) Kütz. Common.

Genus *Tetracyclus* Ralfs.

- T. lacustris* Ralfs. B.
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XII.—*The Foraminifera of the Gault of Folkestone.*—III.

By FREDERICK CHAPMAN, F.R.M.S.

(Read 16th November, 1892.)

PLATES XI. AND XII.

*Sub-family TEXTULARIINÆ—continued.**

TRITAXIA Reuss [1860].

Tritaxia tricarinata Reuss, plate XI. figs. 1 a, b.

Textularia tricarinata Reuss, 1845, Verstein. böhm. Kreid., pt. i. p. 39, plate viii. fig. 60. *Tritaxia tricarinata* Reuss, 1860, Sitzungsber. k. Ak. Wiss. Wien, vol. xl. p. 228, plate xiii. figs. 1, 2.

This form is easily distinguished from the succeeding one by the rounded salient edges, the comparative smoothness of its test, and the more elongate form. It appears to bear the same relation towards *T. pyramidata* as *Verneuilina triquetra* does to *V. variabilis*. *T. tricarinata* is found in its most flourishing condition, both as

EXPLANATION OF PLATES.

PLATE XI.

- Fig. 1a, b.—*Tritaxia tricarinata* Reuss. × 45.
 ,, 2a, b. ,, *pyramidata* Reuss. × 45.
 ,, 3a, b.—*Spiroplecta annectens* Parker and Jones sp. × 60.
 ,, 4. ,, *complanata* Reuss sp. × 45.
 ,, 5. ,, *prælonga* Reuss sp. × 45.
 ,, 6. ,, *anceps* Reuss sp. × 60.
 ,, 7.—*Gaudryina filiformis* Berthelin. × 70.
 ,, 8a, b. ,, *pupoides* d'Orbigny. × 60.
 ,, 9a, b. ,, *rugosa* d'Orbigny. × 60.
 ,, 10a, b. ,, *dispansa* sp. n. × 60.
 ,, 11a, b.—*Valvulina conica* Parker and Jones. × 45.
 ,, 12. ,, *fusca* Williamson sp. × 30.

PLATE XII.

- Fig. 1a, b.—*Gaudryina orycona* Reuss. × 60. Fig. 1b, showing the triserial arrangement at the fractured extremity.
 ,, 2.—*Bulimina Orbignyi* Reuss. × 60.
 ,, 3. ,, *obliqua* d'Orbigny. × 60.
 ,, 4. ,, *Presli* Reuss. × 60.
 ,, 5. ,, ,, var. *sabulosa* var. n. × 50.
 ,, 6. ,, *Murchisoniana* d'Orbigny. × 50.
 ,, 7a, b. ,, *obtusa* d'Orbigny. × 60.
 ,, 8. ,, *brevis* d'Orbigny. × 50.
 ,, 9. ,, *pyrula* d'Orbigny. × 60.
 ,, 10a, b. ,, *affinis* d'Orbigny. × 45.
 ,, 11. ,, *polystropha* Reuss. × 160.
 ,, 12a, b.—*Bolivina textularioides* Reuss. × 70.
 ,, 13a, b.—*Pleurostomella obtusa* Berthelin. × 70.
 ,, 14a, b. ,, *alternans* Schwager. × 60.

* See ante, p. 319.

regards profusion and size, in the *Plicatula* bed, zone x., at Folkestone, where it attains a length of 1/15 in. It is recorded by Reuss from Folkestone, and from various strata of Upper Cretaceous age in Germany and Bohemia, including the Gault. It has been recorded by Dr. Brady as a recent tropical form, from one station only, at a depth of 155 fathoms. At Folkestone it is found in zone v., very rare; zone vii., very rare; zone x., very common; zone xi., 50 ft. from the top, very rare; 45 ft., very rare; 35 ft., frequent; 30 ft., common; 25 ft., frequent; 20 ft., very rare; 12 ft., very common; 6 ft., common.

Tritaxia pyramidata Reuss, plate XI. fig. 2 a, b.

Tritaxia pyramidata Reuss, 1862, Sitzungsber. k. Ak. Wiss. Wien, vol. xvi. p. 32, plate i. fig. 9 a, b, c. *T. pyramidata* Berthelin, 1880, Mém. Soc. géol. France, ser. 3, vol. i. No. 5, p. 25, plate i. fig. 9 a-c.

This form was originally described by Reuss from specimens found by him in the *Minimus*-Thon and Flammenmergel of North-west Germany; and he also notes it from Folkestone. It has been recorded by Berthelin from the Gault of Montcley. This somewhat wild-growing form occurs in the Gault in zone vii., rare; zone viii., very rare; zone x., common; zone xi., 50 ft. from the top, common; 30 ft., frequent; 25 ft., frequent; 20 ft., common; 12 ft., common; 6 ft., common.

SPIROPLECTA Ehrenberg [1844].

Spiroplecta annectens Parker and Jones sp., plate XI. fig. 3 a, b.

Textularia annectens Parker and Jones, 1863, Ann. and Mag. Nat. Hist., ser. 3, vol. xi. p. 92, woodcut, fig. 1. *Spiroplecta annectens* Brady, 1883, Chall. Rep., vol. ix. p. 376, plate xlv. figs. 22, 23 a, b.

In many *Textularian* forms there is a more or less decided tendency for the test to commence spirally, before taking on the biserial arrangement of the chambers. In the case of those spirally commenced forms which can be referred to their *Textularian* equivalents, I have retained the specific name whilst placing them in the genus *Spiroplecta*, and such an example may be found in the *Spiroplecta annectens*; other forms there are, however, which do not resemble any type species of *Textularians*, and in these cases it is convenient to give distinct specific names. This form has been recorded from the Gault of the South-east of England and of Biggleswade, by Messrs. Parker and Jones, and from the latter locality the specimens obtained were so extraordinarily developed that they exhibited a trimorphous arrangement, commencing spirally, proceeding biserially, and ending uniserially. By the kindness of Professor Rupert Jones I have had an opportunity of examining the specimens of *Spiroplecta* collected from the two localities above mentioned, and also the privilege of seeing the notes and drawings made by the late Professor Kitchen Parker referring to the same.

The specimens of *S. annectens* from the Gault generally depart somewhat from the complanate form by the flat spiral portion being almost at right angles to the succeeding biserial portion. The specimens obtained from Folkestone by myself exhibit the trimorphous characters, but the uniserial portion is at most only represented by two chambers, whereas the Biggleswade specimens possess as many as four chambers in a straight line. The recent specimens of *S. annectens* recorded by Brady from Torres Strait are very regular in form and the spiral portion is well developed. In the Folkestone Gault it occurs in zone v., common; zone xi., 45 ft. from the top, frequent; 30 ft., very rare; 25 ft., frequent.

Spiroplecta complanata Reuss sp., plate XI. fig. 4.

(Type form) *Proroporus complanatus* Reuss, 1860, Sitzungsber. k. Ak. Wiss. Wien, vol. xl. p. 231, plate xii. fig. 5 a, b.

The *Textularian* type, *T. complanata* Reuss sp., has been recorded by Dr. Reuss, as rare, from the Gault of the Rhine, and by Messrs. Burrows, Sherborn, and Bailey from the Red Chalk of Speeton. From Professor Parker's MS. notes is the following:—"The Biggleswade Gault specimens answer, many of them, to Reuss's *Proroporus complanatus*, having the last cell opening at the extremity of the axis; but they are often biform, and triform." In the Folkestone Gault it occurs in zone v., very rare; zone xi., 25 ft. from the top, very rare.

Spiroplecta praelonga Reuss sp., plate XI. fig. 5.

(Type form) *Textularia praelonga* Reuss, 1845, Verst. böhm. Kreid., vol. i. p. 39, plate xii. fig. 14.

This form agrees with the specimens of *T. praelonga* from Folkestone previously figured (see this Journal, 1892, plate VI. fig. 23), with the exception that it commences with a distinctly spiral growth. From the fact that this form is found in three out of four of the horizons in company with *T. praelonga* we may infer that the two forms are intimately allied; and further, that possibly the two "genera" of *Textularia* and *Spiroplecta* are in some way connected with the obscure problem of "dimorphism." The specimen figured by Messrs. Burrows, Sherborn, and Bailey under the name of *S. biformis* is possibly the same as *S. praelonga*. Zone xi., 50 ft. from the top, rare; 45 ft., frequent; 25 ft., common.

Spiroplecta anceps Reuss sp., plate XI. fig. 6.

(Type form) *Textularia anceps* Reuss, 1845, Verst. böhm. Kreid., i. p. 39, plate viii. fig. 79; plate xiii. fig. 2.

This *Spiroplectiform* variety of *T. anceps* is represented by one specimen only, from zone xi., 45 ft. from the top.

GAUDRYINA d'Orbigny [1840].

Gaudryina filiformis Berthelin, plate XI. fig. 7.

Gaudryina filiformis Berthelin, 1880, Mém. Soc. géol. France, ser. 3, vol. i. No. 5, p. 25, plate i. fig. 8.

This form was first described by M. Berthelin from the Gault of Montcley in the North of France. It has also been found in recent soundings at depths varying from 390–620 fathoms (Brady); and from shallow-water dredgings yielding small specimens from Ireland and Scotland (Wright, Balkwill and Robertson). This form is well distributed throughout the Folkestone Gault; occurring in zone i., specimen *a*, very rare; zone i., specimen *b*, very rare; zone ii., specimen *b*, rare; zone ii., specimen *c*, very rare; zone iii., rare; zone iv., rare; zone v., very rare; zone vii., very rare; zone ix., very rare; zone xi., 55 ft. from the top, very rare; 35 ft., rare; 25 ft., very rare.

Gaudryina pupoides d'Orbigny, plate XI. fig. 8 *a*, *b*.

Gaudryina pupoides d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 44, plate iv. figs. 22–24. *G. pupoides* Brady, 1884, Chall. Rep. vol. ix. p. 378, plate xlv. figs. 1–4.

A common and well distributed form throughout the Gault and Chalk. It has been recorded from the Neocomian beds of North Germany (Reuss); the Folkestone Gault (T. Rupert Jones in Morris's Catalogue, 2nd edition); the Red Chalk of Speeton (Burrows, Sherborn, and Bailey); the Upper Greensand and Chalk-Marl of Cambridge (G. R. Vine); and the Chalk of France and England (d'Orbigny). The specimens found by M. Berthelin in the Gault of France given under the names of *G. spissa* and *G. gradata* are probably local differentiations of this type; in the Folkestone Gault are found specimens varying in length and in the inflation of the triserial commencement, but as no distinct separation can be made between the forms it seems advisable to record them as *G. pupoides*. It is found in zone i., specimen *b*, common; zone ii., specimen *a*, frequent; zone iii., very rare; zone v., very rare; zone vi., very rare; zone viii., very rare; zone ix., frequent; zone x., very common; zone xi., 50 ft. from the top, very common; 45 ft., very common; 40 ft., rare; 35 ft., very common; 30 ft., very common; 25 ft., very common; 12 ft., frequent.

Gaudryina rugosa d'Orbigny, plate XI. fig. 9 *a*, *b*.

Gaudryina rugosa d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 44, plate iv. figs. 20, 21. *G. rugosa* Hantken, 1875, Mittheil. Jahrb. d. k. ung. géol. Anstalt, vol. iv. p. 13, plate i. fig. 4.

This species is distinguished from *G. pupoides* by the rough texture of the shell, and the sharply triangular shape of the triserial

portion. It is characteristic of the Cretaceous strata, and has also been found in the Middle Tertiary beds of Hungary (Hantken). The recent forms described by Brady were found in and near the tropics at depths varying from 11 to 675 fathoms. In the Gault of Folkestone it appears in zone x., very rare; zone xi., 50 ft. from the top, frequent; 45 ft., common; 35 ft., very rare; 25 ft., very rare.

Gaudryina oxycona Reuss, plate XII. fig. 1 *a, b*.

Gaudryina oxycona Reuss, 1860, Sitzungsber. k. Ak. Wiss. Wien, vol. xl. p. 229, plate xii. fig. 3 *a, b c*.

The figure given by Reuss, from a Westphalian-Chalk specimen, is more regular in the general outline of the shell, and less compressed than the Gault specimens; otherwise they agree in all essential characters; Reuss also found this species in the Gault of the Rhine. Fig. 1 *b* shows the three-chambered commencement of the aboral pointed end slightly fractured. The species has also been found in the Gault of Montcley in the north of France (Berthelin). In the Folkestone Gault this form occurs in zone xi., 12 ft. from the top, common; 6 ft., very rare.

Gaudryina dispansa, plate XI. fig. 10 *a, b*.

A form of *Gaudryina* of a somewhat distorted appearance was met with in the Gault, reminding one at first glance of the *G. baccata* of Schwager.* It appears, however, to possess decided characters of its own; the chambers (which would, in their normal condition, be arranged as in *G. pupoides*) are developed in a series flattened in the direction of the length of the shell, whilst the margins of the chambers are slightly overlapping. In *G. baccata* the chambers are always more or less inflated. The texture of the test of *G. dispansa* is the same as that of *G. pupoides*; and the aperture a *Textularian* slit, slightly twisted. This species attains the length of 1/40 in. It is found in zone viii., very rare; zone x., rare; zone xi., 40 ft. from the top, rare.

VALVULINA d'Orbigny [1826].

Valvulina conica Parker and Jones, plate XI. fig. 11 *a, b*.

Valvulina triangularis Parker and Jones, 1857, Ann. and Mag. Nat. Hist., ser. 2, vol. xix. p. 295, plate xi. figs. 15, 16. *V. triangularis* var. *conica* Parker and Jones, 1865, Phil. Trans., vol. clv. p. 406, plate xv. fig. 27. *V. conica* Brady, 1884, Chall. Rep., vol. ix. p. 392, plate xlix. figs. 15, 16.

This is a conspicuous form in the Gault series, and agrees very well with the figures and descriptions of *V. conica*, with the exception that the Gault specimens are free, and without any signs of ever having been attached. There is just the possibility of the above

* Novara-Exped., 4to, Wien. Geol. Theil, ii. (1866) p. 200, pl. iv. fig. 12.

form being a *Valvuline* modification of *Textularia conica*, from which it is distinguished by the triserial and twisted arrangement of the chambers, and the flange which projects over the aperture of the mouth. It appears not to have been found before in the fossil state. It occurs in zone i., specimen *a*, very rare; zone v., very rare; zone xi., 50 ft. from the top, very rare; 45 ft., very rare; 35 ft., rare; 25 ft., very rare.

Valvulina fusca Williamson sp., plate XI. fig. 12.

Rotalina fusca Williamson, 1858, Rec. For. Gt. Br., p. 55, plate v. figs. 114, 115. *Valvulina fusca* Brady, 1884, Chall. Rep., vol. ix. p. 392, pl. xlix. figs. 13, 14.

This form also is here recorded as a fossil for the first time. Some of the specimens found resemble in the minutest details the recent specimens figured by Dr. Brady. It is noted as a shallow-water form, though found occasionally at as great depths as 500 or 600 fathoms. Many of the specimens from the Gault have become detached, but their adherent nature can be easily made out. The texture of the shell of some of the specimens is much finer than that of the one figured. The specimens occur in zone iii., very rare; zone vii., rare; zone x., rare.

Sub-family BULIMININÆ.

BULIMINA d'Orbigny [1826].

Bulimina Orbigny Reuss, plate XII. fig. 2.

Bulimina d'Orbigny Reuss, 1845, Verst. böhm. Kreid., vol. i. p. 38, plate xiii. fig. 74.

This elegant form is easily recognized by the long and gradually tapering shell, and by the deeply set oral aperture. It is the largest species of *Bulimina* in the Gault series. Reuss records it from the Gault of Folkestone and of the Rhine, as well as from many localities in N. Germany and Bohemia from various strata throughout the Upper Cretaceous series. It is fairly well distributed in the Gault of Folkestone, being found in zone i., specimen *b*, very rare (small var.); zone viii., common; zone ix., rare; zone x., common; zone xi., 45 ft. from the top, very rare; 20 ft., common; 12 ft., frequent; 6 ft., frequent.

Bulimina obliqua d'Orbigny, plate XII. fig. 3.

Bulimina obliqua d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 40, plate iv. figs. 7, 8.

A well-known form in the Chalk of France and England. It has also been found in the Phosphatic beds of Cambridge (G. R. Vine) and previously in the Gault of Kent (T. Rupert Jones in Morris' Catalogue, 2nd ed.). At Folkestone it occurs in zone viii., frequent;

zone x., frequent; zone xi., 55 ft. from the top, very rare; 45 ft., very rare; 25 ft., frequent; 20 ft., very common.

Bulimina Presli Reuss, plate XII. fig. 4.

Bulimina Presli Reuss, 1845, Verst. böhm. Kreid., vol. i. p. 38, plate xiii. fig. 72.

A very common form in the Chalk. Also from the Red Chalk (Burrows, Sherborn, and Bailey); the Gault of Montcley (Berthelin); and previously from the Gault of Folkestone (T. R. Jones in Geol. Surv. Mem. "The Weald"). This species is perhaps the most extensively distributed and characteristic form of the Gault *Buliminæ*; occurring in zone vi., rare; zone vii., very common; zone viii., frequent; zone ix., common; zone x., common; zone xi., 55 ft. from the top, very common; 50 ft., very rare; 45 ft., frequent; 40 ft., common; 35 ft., rare; 30 ft., frequent; 25 ft., common; 20 ft., common; 12 ft., rare; 6 ft., common.

Bulimina Presli Reuss, var. *sabulosa*, plate XII. fig. 5.

In general form it resembles *B. Presli*, but since the specimens found keep their character of shell-structure distinct they appear to merit at least a varietal name. The test is composed of sandy particles as in *B. Presli*, but many of the fragments are much larger than are usually seen in the shells of the *Buliminæ*, the surface generally being exceedingly rough. Length 1/24-1/40 in. Found in zone xi., 20 ft. from the top, very common; 12 ft., very common; 6 ft., very common.

Bulimina Murchisoniana d'Orbigny, plate XII. fig. 6.

Bulimina Murchisoniana d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 41, pl. iv. figs. 15, 16. *B. Murchisoniana* Reuss, 1845, Verst. böhm. Kreid., vol. i. p. 37, pl. viii. figs. 69, 72 and pl. xiii. fig. 70.

This form has the last three or four chambers very much inflated, the sutural furrows strongly marked, the aboral end tapering suddenly to a sharp point. It is a species well known from the Chalk of England, France, Germany, and Bohemia (Rupert Jones, d'Orbigny, Reuss); and also noted from the Phosphatic beds of Cambridge (G. R. Vine), but apparently unknown from the Gault. It occurs in zone xi., 45 ft. from the top, very rare; 40 ft., common; 35 ft., rare; 30 ft., very rare; 20 ft., rare; 12 ft., frequent; 6 ft., rare.

Bulimina obtusa d'Orbigny, plate XII. fig. 7 a, b.

Bulimina obtusa d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 39, pl. iv. figs. 5, 6. *B. truncata*, Reuss, 1845, Verst. böhm. Kreid., vol. i. p. 37, pl. viii. fig. 73.

Recorded previously from the Gault of Kent (T. R. Jones in Morris' Catalogue, 2nd ed.), is common in the Chalk of France and England, and has been found in the Phosphatic beds of Cambridge (G. R. Vine); Reuss figures what is apparently the same form under the name of *B. truncata*, from the Bohemian Chalk. In the Folkestone Gault it occurs in zone xi., 55 ft. from the top, very rare; 45 ft., very rare; 6 ft., very rare.

Bulimina brevis d'Orbigny, plate XII. fig. 8.

Bulimina brevis d'Orbigny, 1840, Mém. Soc. géol. France, vol. iv. p. 41, pl. iv. figs. 13, 14.

A common form in the Chalk of France and England, but not before met with in the Gault. It is found in zone xi., 40 ft. from the top, rare; 35 ft., very rare; 30 ft., frequent; 12 ft., common; 6 ft., common.

Bulimina pyrula d'Orbigny, plate XII. fig. 9.

Bulimina caudigera, d'Orbigny, 1826, Ann. Sci. Nat., vol. vii. p. 270, No. 16;—Modèle, No. 68. *B. pyrula*, d'Orbigny, 1846, For. Foss. Vien., p. 184, plate xi. figs. 9, 10. *B. pyrula*, Brady, 1884, Chall. Rep., vol. ix. p. 399, plate l. figs. 7–10.

The earliest appearance which this form makes is in the beds of Chellaston (Upper Triassic? Parker and Jones); it has also been found in beds of Eocene, Miocene, Pliocene, and Post-pliocene ages; its occurrence therefore at Folkestone supplies a link in the chain of records. As a recent form it occurs alike in shallow- and deep-water deposits. At Folkestone it is found in zone xi., 35 ft. from the top, rare; 12 ft., very rare.

Bulimina affinis d'Orbigny, plate XII. fig. 10 *a, b*.

Bulimina affinis, d'Orbigny, 1839, Foram. Cuba, p. 109, plate ii. figs. 25, 26. *B. affinis*, Brady, 1884, Chall. Rep. vol. ix. p. 400, plate l. fig. 14 *a, b*.

The Gault specimens resemble very closely those obtained from soundings by the 'Challenger.' As a recent form it affects shallow and deep water alike. It is also recorded from the Red Chalk of Speeton (Burrows, Sherborn, and Bailey). In the Gault it is found in zone v., very rare; zone ix., very rare; zone xi., 55 ft. from the top, very rare; 35 ft., very rare; 20 ft., common; 12 ft., common; 6 ft., common.

Bulimina polystropha Reuss, plate XII. fig. 11.

Bulimina polystropha Reuss, 1845, Verstein. böhm. Kreid., vol. ii. p. 109, plate xxiv. fig. 53. *B. polystropha*, Berthelin, 1880, Mém. Soc. géol. France, ser. 3, vol. i. No. 5, p. 30, plate ii. fig. 3 *a, b*.

In the Gault are innumerable examples of a tiny vitreous-shelled Foraminifer, which appear more closely related to Reuss's specimens from the Bohemian Chalk (as has been pointed out by M. Berthelin in his description of similar forms from the Gault of Montceley), than to the recent forms with a sandy test, described under the name of *Verneuilina polystropha* (Parker, Jones, and Brady). The Gault specimens have an abnormal *Bulimine* oral aperture, somewhat semi-circular in outline, but their relation to the *Buliminæ* appears to be established by the presence of some fine radiating striæ round the aperture. This very minute form, one of the smallest in the Gault series, and found only in the finest siftings, occurs in zone xi., 55 ft. from the top, very rare; 50 ft., rare; 45 ft., common; 40 ft., common; 35 ft., common; 30 ft., common; 25 ft., common; 20 ft., very common; 12 ft., very common; 6 ft., frequent.

BOLIVINA d'Orbigny [1839].

Bolivina textularioides Reuss, plate XII. fig. 12 *a, b*.

Bolivina textularioides, Reuss, 1862, Sitzungsab. k. Ak. Wiss. Wien, vol. xvi. p. 81, plate x. fig. 1.

This form has been found in the Middle Hills formation of North Germany (Reuss); in the Red Chalk of Speeton (Burrows, Sherborn, and Bailey); in the Gault of the North of France (Berthelin); and as a recent form both in shallow and deep water (Brady). It is a very characteristic form found generally distributed throughout the Gault. It occurs in zone i., specimen *b*, common; zone ii., specimen *a*, very common; zone ii., specimen *b*, frequent; zone ii., specimen *c*, frequent; zone iii., common; zone iv., frequent; zone v., rare; zone ix., frequent; zone x., rare; zone xi., 50 ft. from the top, frequent; 45 ft., common; 40 ft., common; 35 ft., frequent; 30 ft., frequent; 25 ft., frequent; 20 ft., very common; 12 ft., common; 6 ft., frequent.

PLEUROSOMELLA Reuss [1860].

Pleurostomella obtusa Berthelin, plate XII. fig. 13 *a, b*.

Pleurostomella obtusa Berthelin, 1880, Mém. Soc. géol. France, ser. 3, vol. i. No. 5, p. 29, plate i. fig. 9 *a, b*.

One of the forms of *Pleurostomella* found in the Folkestone Gault agrees with the figures given by M. Berthelin, and differs from the Chalk specimens figured by Reuss in some apparently essential points. Some specimens described under the name of *P. subnodosa* Reuss, have been noted by Messrs. Burrows, Sherborn, and Bailey from the Red Chalk of Speeton, which closely approach the Gault species. *P. obtusa* is found in the Gault in zone i., specimen *b*, frequent; zone ii., specimen *a*, very rare; zone ii., specimen *b*, very rare; zone v., frequent; zone viii., very rare; zone xi., 50 ft. from the top, very rare; 45 ft., rare; 40 ft., very rare; 30 ft., very rare; 25 ft., frequent; 20 ft., common; 12 ft., frequent.

Pleurostomella alternans Schwager, plate XII. fig. 14 *a, b*.

Pleurostomella alternans Schwager, 1866, Novara-Exped., 4to, Wien, Geol. Theil, vol. ii. p. 238, plate vi. figs. 79, 80. *P. eocæna*, Gümbel, 1868, Abh. k. bay. Ak. Wiss., vol. x. p. 630, plate i. fig. 53. *P. Reussi*, Berthelin, 1880, Mém. Soc. géol. France, ser. 3, vol. i. No. 5, p. 28, plate i. fig. 10 *a, b*; 11, 12. *P. alternans* Brady, 1884, Chall. Rep., vol. ix. p. 412, plate li. figs. 22, 23.

This form is distinguished from the preceding by the pointed extremity; and it also frequently exhibits a *Textularian* arrangement of the segments at its commencement. This species is the commoner of the two found in the Gault of Folkestone, and this fact is also noted by M. Berthelin regarding the French Gault; he, however, found a third form occurring rarely. *P. alternans* is a well-known Tertiary fossil, and is also recorded from the Red Chalk of Speeton (Burrows, Sherborn, and Bailey). It is found in the Folkestone Gault in zone i., specimen *b*, frequent; zone ii., specimen *a*, very rare; zone v., very rare; zone xi., 55 ft. from the top, very rare; 50 ft., very rare; 40 ft., rare; 25 ft., very common; 20 ft., common; 12 ft., frequent.

Erratum.—In Part II. of this paper, *ante*, p. 324, line 2, strike out the words “and Wealden beds.”

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Gamophagy.‡—Herr J. Müller believes that one germinal substance assimilates or devours the other with which it has become intimately associated in fertilization. His theory is more or less analogous with the opinions of those who believe that fertilization includes a chemical influence between substances qualitatively different, and is, therefore, it is hardly necessary to say, far from harmonizing with Weismann's theory of Amphimixis which the author criticizes.

Theory of the Mesoderm.§—Prof. C. Rabl continues his discussion of the mesoderm, with special reference to embryos of *Pristiurus*. We cannot do more than notice a few of his conclusions. The vertebral bodies arise by a gradual differentiation of the skeletogenous sheath from without inwards. Long before the appearance of the bodies the arches and intercalated pieces are formed, and also the transverse muscle-septa. Perhaps the centripetal progress is also true phylogenetically.

The ribs have no genetic connection with the ventral arches, although at an early date connected with them. At no time do the ribs appear as direct prolongations or as lateral processes of ventral arches, but are throughout independent. But there are ribs and ribs. The ribs ("pleural arches") of Ganoids, Teleosteans, and Dipnoi arise

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, &c., which are either new or have not been previously described in this country.

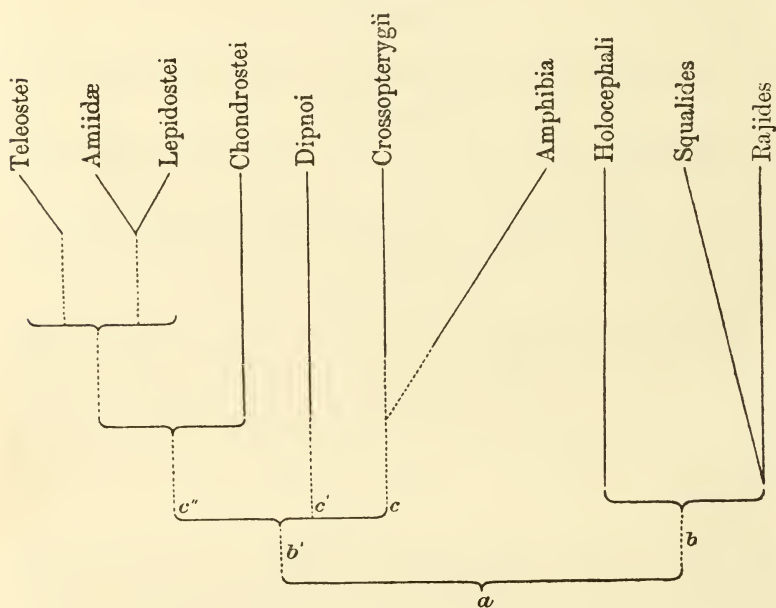
† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, and Reproduction, and allied subjects.

‡ 'Ueber Gamophagie. Ein Versuch zum weiteren Ausbau der Theorie der Befruchtung und Vererbung,' Stuttgart, 1892. Bot. Centralbl., li. (1892) pp. 279-80.

§ Morphol. Jahrb., xix. (1892) pp. 65-144, pls. iv.-vii. and figs. 10-13.

on the boundary lines of the transverse muscle-septa and the subperitoneal connective tissue, apparently in direct connection with the rudiments (*Stümpfen*) of the ventral arches; but the ribs of Selachii, Amphibia, and Amniota arise on the boundary lines of the transverse and the horizontal muscle-septa, quite independently of the vertebral column.

Beginning with ancestral forms (*a*), (*b*), and (*b'*), with ribs which lay between the dorsal and ventral muscles, Rabl supposes these to have been lost in *c'* and *c''*, and to have been replaced by subperitoneal skeletal parts ("pleural arches" of Goette). On the other hand in the ancestral form (*c*) these pleural arches must have been formed along with the ribs inherited from (*b'*) and (*a*). In a separate chapter Prof. Rabl enters upon a discussion of the origin of limbs, but the memoir is not yet fully published.



Yolk-Organ of Vertebrates.* — Dr. Hs. Virchow continues his account of the "yolk-organ." The yolk-sac entoblast of reptiles has a double origin, from the one-layered parietal epithelium and from the yolk-cells. These are separated by the perilecithal cleft. The parietal epithelium appears in two forms, as ripe epithelium with high cells, and as early epithelium with flat cells on the proximal wall of the yolk-sac—the roof of the subgerminal cavity. Preceding the mature one-layered epithelium there is the layered epithelium; preceding the layered epithelium there is the formation of cells in the yolk; and

* Archiv f. Mikr. Anat., xl. (1892) pp. 39-101 (2 pls.).

preceding this there is the layered, yolk-free, lecithoderm. From the merocytes in the floor of the subgerminal cavity there is during the diblastic stage of the germ an abundant giving off of cells on the lower germinal layer over its whole extent; at the beginning of gastrulation there is an abundant proliferation at the marginal pad of the lecithoderm, especially on its distal zone; but whether the merocytes continue to form cells in later stages is undecided. So is the fate of the merocytes. The yolk-cells first appear superficially, finally in the centre. They probably arise from yolk-free cells, which in the middle stages of development occur abundantly in the perilecithal cleft and in the superficial layers of the internal yolk-mass. The yolk-cells may disappear without becoming yolk-sac epithelium; but this is uncertain. In the final state there are two forms of cells: yolk-cells and ripe yolk-sac epithelial cells; and there are five preliminary forms—merocytes, lecithoderm cells (early epithelium), yolk-free cells of the lecithoderm margin, very minute yolk-free cells and other yolk-free cells round and flat.

The yolk-organ of reptiles is in its parietal layer like that of birds, in its internal cell-mass like that of amphibians. The development of the wall shows four stages, as in birds. The yolk-cells do not develop by yolk-segmentation as in amphibians, but arise from the formation of yolk-free cells from the parietal layer. It is possible, however, that the merocytes produce a first generation of non-persistent yolk-cells. The yolk-cells and the yolk-sac epithelial cells are originally homologous; the latter are morphologically derivable from the former. In birds the palingenetic formation of yolk-cells appears to have been entirely lost.

Vertebræ and Protovertebræ.*—Prof. V. v. Ebner notes that the cartilaginous vertebræ of snakes (and perhaps of all Amniota) develop earlier than the cartilaginous arches; that the so-called “primitive vertebral arches” of Amniota are embryonic structures which cannot be brought into direct relation with any definite skeletal parts; they are metameric vertebral streaks. Corning’s protovertebral cleft is the same as his intervertebral cleft, and both correspond to von Ebner’s intervertebral cleft, which however is not identical with the articular cavity. The primitive constrictions of the notochord, as described by Corning in blind-worms, have no persistent importance; the permanent constrictions develop after the beginning of the vertebral ossification in association with the formation of the articular surface and cavity. The latter appears long after the intervertebral cleft has disappeared from the intervertebral cartilage. The intervertebral cleft disappears entirely outside the vertebral body; the intervertebral foramen does not represent it. The cleft does not lie in a myoseptum, for the latter represents the boundary of two protovertebræ, whereas the former corresponds to the cranio-caudal middle region of a protovertebra.

Parietal Eye and Nerve.†—Prof. E. Béranek, having studied the parietal nerve and the pineal body, especially in *Anquis fragilis*, comes to the following conclusions. The parietal eye is not a simple diver-

* SB. K. Akad. Wiss. Wien, ci. (1892) pp. 235-60 (1 pl.).

† Anat. Anzeig., vii. (1892) pp. 674-89 (6 figs.).

ticulum of the pineal body. In *Lacerta* and *Anguis* it arises from the thalamencephalon independent of, though parallel to the epiphysis. It is supplied by a transitory nerve not derived from the epiphysis, and grows from a parietal centre between the base of the pineal gland and the first fold of the choroid plexus. The third eye is an optic vesicle evaginated from the thalamencephalon; the separation between crystalline and retinal portion is usually unilateral, rarely bilateral, and is late in appearing, therefore not suggestive of a dual origin of the eye. Distinct in Cyclostomata and Reptilia, it is rudimentary in Teleostei and Amphibia, absent in Selachii. The epiphysis does not represent the stalk of the parietal eye; it is equally old, constant in occurrence, and of entirely unknown function. The paraphysis is a diverticulum of the fore-brain, which may give rise to one or more secondary vesicles; it appears in Selachii after the epiphysis and parietal eye, and shows no hint of ancestral sensory functions. Of these only the parietal eye preserves any trace.

Vertebrate Ear.*—Mr. H. Ayers devotes the second of his studies on "Vertebrate Cephalogenesis" to a study of the ear, in which he enters upon a number of points which it is not our duty to record here. We must content ourselves with stating that he considers the Vertebrate ear to be a relatively late acquisition, and that among the Sauropsida and Mammalia it is the only remnant of the canal-organs of their ichthyopsid ancestors. He concludes that the surface territory out of which the ear developed was the best offered by the anatomical conditions of the ancestors of present Vertebrates; the superiority of this territory lay in its combining in small space two differently innervated sensory apparatuses of a kind suitable for the further perfection of the function of the perception of wave motion. Among the higher forms the semicircular canals are degenerating, and one canal-organ, the crista abortiva, has entirely disappeared. Corti's organ is not, as Retzius concludes, the papilla basilaris, but only a small portion of it, which has undergone peculiar modifications.

The auditory organs of Invertebrates are not the forerunners of the Vertebrate auditory organ, but are differentiated structures which are strictly confined to them.

Cleavage of Amphibian Ovum.†—Messrs. E. O. Jordan and A. C. Eycleshymer have a preliminary notice of their observations on the cleavage of the ovum of various Amphibia. By the use of plane mirrors they avoided the necessity of changing the position of the egg. Though the first meridional furrow usually divides the egg into two subequal portions one cell is sometimes twice as large as the other; so, again, though the second meridional furrow is generally at right angles to the first the two may form quite acute angles with one another. The third set of furrows is usually equatorial, but there are all possible variations between a true equatorial and a true vertical. In the fourth set of furrows each quadrant usually exhibits radical individual differences, and if the third set of furrows is irregular the fourth is hopelessly intricate. As the embryos formed were quite

* Journ. of Morphol., vi. (1892) pp. 1-360 (12 pls.).

† Anat. Anzeig., vii. (1892) pp. 622-4.

normal it is clear that irregularities of cleavage have no appreciable effect on any stage of development of the embryo.

Vascular Papillæ in Discus proligerus of Capra.*—Dr. C. Crety describes vascular papilliform diverticula from the follicular theca, which penetrate more or less into the follicular epithelium in that zone which is in immediate connection with the discus proligerus. The histogenetic processes consist in a proliferation of the elements of the tunic of Henle and in the formation of new elements between the tunic of Henle and the fibrous tunic. It may be that the papillæ, which are rich in blood-vessels, facilitate the nutrition of the ovum.

Development of the Squirrel.†—Dr. E. Fiserius gives an account of the development of *Sciurus vulgaris*, which though it contains no new discovery, deserves to be recorded as a lucid corroboration of much that is old.

Development of Bladder.‡—Dr. W. Nagel has studied embryos of man, rabbit, guinea-pig, and cow, in order to elucidate the development of the bladder. His results do not harmonize with those of Keibel or of His. According to Nagel, the ureters which at first open into the Wolffian ducts gradually separate themselves from these, and come to open into the allantoic duct independent of, but at the same level as the Wolffian ducts. Thereafter there begins on the allantoic duct, above the opening of the four ducts, the development of the urinary bladder, and the ureters being loosed from all connection with the Wolffian ducts have their openings gradually shunted upwards until they attain their final position.

Development of the Pancreas.§—Herr O. Hamburger finds that the pancreas in man arises from two originally separate rudiments. The smaller, at first separate, subsequently opens along with the bile-duct, into the duodenum; the larger opens nearer the pylorus. In the second half of the second month of foetal life the two rudiments anastomose. The small duct of Santorini in the adult is not the duct of the smaller pancreas-rudiment, but arises from a portion of main rudiment, lying between the intestine and the region where the two rudiments coalesce.

Dentition of Young Edentata.||—Dr. C. Röse has investigated the development of the teeth in embryos of *Dasypus novemcinctus*, *D. hybridus*, *Manis javanica*, and *Myrmecophaga*, and comes to the general conclusion that the dentition of Edentates is due to degeneration from a more highly organized type. The enamel, as is well known, is very rudimentary. In *Dasypus novemcinctus* (Tomes, Kükenenthal, Röse), *D. villosus* (Kükenenthal), *D. hybridus* (Röse), *Orycteropus capensis* (Pouchet and Chabry), two sets of teeth are represented in the embryo. Like Kükenenthal, Röse believes that the milk dentition of mammals is no new acquisition, but a phyletic inheritance, and derivable in all likelihood from the compression of several reptilian-like teeth-series into one. As

* Atti (Rend.) R. Accad. Lincei, 1892, pp. 402-8 (4 figs.).

† Verh. Physik-med. Gesell. Würzburg, xxvi. (1892) pp. 103-22 (1 pl.).

‡ SB. K. Preuss. Akad. d. Wiss., 1892, pp. 177-81.

§ Anat. Anzeig., vii. (1892) pp. 707-11 (3 figs.).

|| Tom. cit., pp. 495-512 (14 figs.).

Glyptodon has prismatic back teeth of triconodont type, it is likely that of the biconodont back teeth of modern Edentates the posterior at least have arisen by the reduction of triconodont forms. According to Röse the difference between molars and premolars depends on the number of single conical teeth which have coalesced in either case.

Enamel Organ in Edentate.*—Dr. E. Ballowitz describes in the embryo of *Dasyppus* the presence of a distinct enamel organ, as previously noticed by Tomes and by Pouchet and Chabry. But Ballowitz has discovered that it is more than embryonic; a portion—the lower margin—persists as an epithelial ring at the base of the pulp-papilla. As it lies at the area whence the tooth continues throughout life to grow, it may be that the formation of the dentine involves the co-operation of the enamel organ. Of its great importance the author is confident.

Apical Spot in Embryos of Swimming Birds.†—Herr A. Klincowström has found in embryos of *Sterna hirundo*, *Larus canus*, *L. marinus*, *L. glaucus*, and *Anser brachyrhynchus*, an "apical spot" which lies a little behind the top of the pineal outgrowth, "on that part of the head-surface towards which the pineal body is directed before its follicular modification begins." On this spot, before there is any rudiment of feather-papillæ, the epidermis is differentiated as a slight elevation which becomes pigmented. A cupola-like protrusion is formed, which subsequently seems to be divided into two. In the middle of this protrusion the epidermis proliferates and forms several thin sagittal ridges. Finally, in the corium a mass of pigment accumulates and forms the "apical spot." Subsequently it more or less completely disappears. Is it a constriction of the pineal apex, or an integumentary structure which has only secondary relations with the pineal body? Is it a homologue of the frontal spot of Anura or comparable merely to the pineal scale of reptiles? To the last interpretation the author inclines.

Origin of Pigment in Bufo.‡—Herr F. Winkler finds that the pigment is present in the ova from the first. During development it is formed by a modification of yolk-plates. It occurs in all three layers, but especially in ectoderm and endoderm. In all the actively formative cells it increases in the protoplasm. For the young embryo at least, its origin cannot be the result of a modification of hæmoglobin.

Leptocephalidæ.§—SS. G. B. Grassi and S. Calandruccio give a preliminary statement of their observations on the metamorphosis of Leptocephalidæ into Murenidæ of which they are the normal larvæ. It has been experimentally proved that *Leptocephalus morrisoni*, *L. punctatus*, and another form not described are the larvæ of *Conger vulgaris*; that *L. diaphanus* is the larva of *Congromuræna balearica*; *L. Köllikeri* of *Congromuræna mystax*; *L. Kefersteini* of *Ophichthys serpens*.

Abnormal Segmentation.||—Dr. E. O. Strachley describes the remarkable absence of nuclei in artificially fertilized ova of the trout.

* Arch. f. Mikr. Anat., xl. (1892) pp. 133-56 (2 pls.).

† Zool. Jahrb., v. (1892) pp. 177-83 (1 pl.).

‡ MT. Embryol. Inst. K. K. Univ. Wien, 1892, pp. 64-80.

§ Atti (Rend.) R. Accad. Lincei (1892) pp. 375-9.

|| MT. Embryol. Inst. K. K. Univ. Wien, 1892, pp. 20-2.

Although segmentation made some progress, there were no nuclei to be seen, and the abnormal process speedily came to a standstill.

B. Histology.

Central Corpuseles.*—Dr. R. Fick protests against O. Bürger's interpretation of the central corpuseles as merely the results of the attraction and compression of microsomata. He maintains that it is warrantable to regard them, especially since they are known to divide, as independent specialized constituents of the cell.

Histology and Micro-Chemistry of Blood.†—Dr. J. Weiss discusses in the first place the chemistry of staining. He is emphatic in maintaining that it is not an original substance of the tissue which we see stained in the preparation, but rather the result of all the chemical processes to which the tissue has been subjected. Describing preparations of blood after Ehrlich's methods, he notices that the elective power of the cytoplasm of the mononuclear cells is entirely different from that of the polynuclear leucocytes. Four kinds of unpigmented blood-cells may be chemically differentiated. The polynuclear leucocytes with eosinophilous plasma are distinguished from the polynuclear leucocytes with eosinophilous granules; the first are again distinguished from polynuclear leucocytes with basophilous plasma and these from the mononuclear leucocytes with basophilous plasma. Incidentally the author notes that the multiplication of the eosinophilous cells is quite independent of that of the other leucocytes. As a contribution to the chemistry of the cell-contents, he gives an account of the reactions with cinnamylaldehyde, salicylaldehyde, vanillin, &c.

Nerve-cells of the Sympathetic System of Mammals.‡—Prof. A. Van Gehuchten's observations have led him to the following general conclusions. The nervous elements of the sympathetic are in all points comparable to the elements of the cerebrospinal nervous system. Like them, they are provided with two kinds of prolongations; some are short, protoplasmic and probably "cellulipete," while others are long cylinder-axes and probably "cellulifuge." The number of protoplasmic prolongations is various; they most often have one or two bifurcations before ending in the neighbouring cells, but in some cases they remain undivided. They always end freely, and the arrangement in a circumcellular nest is accidental, and has not the importance which Ramon y Cajal has endeavoured to attribute to it. No nervous element has more than one cylinder-axis continuous with a nerve-fibre.

Structure of Optic Lobes of Chick.§—Prof. A. Van Gehuchten finds that in a chick of eighteen to twenty days it is possible to recognize in the optic lobe three more or less distinct layers, which correspond to the three layers which he and M. Martin have lately detected in the olfactory bulb of Vertebrates. The first is the layer of retinal fibres in which there terminate by free ramification and in several planes most of the fibres of the optic tract, while there are also the terminal ramifications

* Anat. Anzeig., vii. (1892) pp. 464-7.

† MT. Embryol. Inst. K. K. Univ. Wien, 1892, pp. 23-63 (1 pl.).

‡ La Cellule, viii. (1892) pp. 83-95 (1 pl.).

§ Tom. cit., pp. 1-43 (3 pls.).

of the peripheral protoplasmic prolongations of all the optic nerve-cells of the median layer. Among these two sets of terminations nerve-cells with a descending cylinder-axis are to be seen. In some cases the cylinder-axis is short, and ends in the superficial parts of the median layer, while in others it is long, and is sometimes continuous with a central optic fibre of the internal layer. The layer of retinal fibres corresponds to the layer of olfactory fibrils of the olfactory bulb of Mammals with some slight histological difference.

The second layer, that of the optic nerve-cells, is formed essentially of cells, all of which send out protoplasmic prolongations among the retinal ramifications of the outer layer. The nervous prolongation of the cells with a long cylinder-axis is sometimes continued into the internal layer, where it becomes a central optic nerve-fibre; in other cases it passes into the outer layer where it becomes a peripheral optic fibre, and, probably, penetrates as far as the deep layers of the retina. The nerve-cells with short cylinder-axes belong to one of two groups, according as their nervous prolongation is peripheral or central.

The layer of central optic fibres is formed essentially of nerve-fibres, the origin of which is double. Sometimes they arise from optic nerve-cells of the median layer, just as the nerve-fibres of the inner layer of the olfactory bulb arise from the ventral cells; in other cases their origin is unknown, and they terminate in the two outer layers. Ramon y Cajal admits the existence of similar fibres in the olfactory bulb of Mammals, though the author was unable to find them.

From the fact that the fibres of the optic nerve end freely in the outer layer of the lobe we may draw the important conclusion that, contrary to what has been hitherto supposed, the optic nerve does not have its origin, but only its termination in the optic lobe.

Spinal Cord and Ganglia of Pristiurus-Embryos.*—Prof. M. v. Lenhossék, using Golgi's and Ehrlich's methods, has corroborated the well-known interpretation of the nervous system which is associated with the names of Kupffer and His. The axis-cylinder process of a motor anterior-horn cell passes from the cord as a peripheral motor fibre, preserving its individuality and its character as the product of a single cell even to its end on a muscle. In the spinal ganglion there is essentially but one kind of cell—a typical bipolar element—of whose processes one may be followed in the cord in the course of the sensory root, while the other extends as a smooth delicate fibre to its terminal ramification between epidermic cells. There is no doubt that the posterior root-fibres, like the peripheral sensory fibres, arise from spinal ganglion-cells. The established histological facts are, according to Lenhossék, quite fatal to Beard's recent conclusions on the histogenesis of nerve.

γ. General.

The Living Organism.†—Sig. F. Ardissonne, from the standpoint of one who is not ashamed of Platonic philosophy, enters a protest against a materialistic conception of organisms. Although his criticisms of

* Anat. Anzeig., vii. (1892) pp. 519-39 (19 figs.).

† 'L'Organismo vivente considerato nella sua essenza e nella sua origine,' Varese, 1892, 8vo, 24 pp.

evolution theories appear to the recorder somewhat futile, and his philosophic cautions familiar, we gladly give his protest due mention. As he says, "La verità non può perire dunque di che temere?"

Principles of Skeleton-forming.*—Dr. F. Dreyer continues his "essay towards a mechanical explanation of organic structures" by a discussion of the skeletons of Rhizopods, Sponges, and Echinodermata. In the present part of his memoir he begins with the tetraxial type in Sponges, Echinoderms, and Polycystina. The fact that the tetraxial type occurs independently in several groups suggests the conclusion that it is conditioned not by the specific vitality of the organisms, but by similar inorganic factors. Its occurrence in different materials suggests independence of protoplasmic forces and dependence on the mechanical influences of the environment. Vesicular bodies exhibit a tetraxial skeletal structure as the result of definite physical conditions—a discussion of which will be found in Dreyer's essay. The skeletal substance is secreted by and in the living matter; it arises by the calcification, or silicifying, or cornification of organic parts, which are dependent on the conditions of vesicular tension and tend to a tetraxial arrangement. The tetraxial skeletons of Sponges, Echinoderms, and Polycystina thus depend on the physical conditions of vesicular tension.

The fourth chapter of Dr. Dreyer's essay deals with mosaic-shells, composed by the apposition of small parts. Here the mechanical conditions are obviously more complex, and some may think that the facts are somewhat beyond the author's theory of "Bildungsmechanik." Finally, in a fifth chapter the author discusses the general problem to the solution of which he has set himself, and in a manner which disarms criticism, acknowledges that he has only taken a step or two towards its solution. That these steps are careful and scholarly and calculated to stimulate inquiry into one of the most difficult of problems, no one can question.

Mechanical Genesis of Scales of Fishes.†—Mr. J. A. Ryder in making an attempt to give a mechanical explanation of the genesis of the scales of Fishes comes to two conclusions, which he thinks of importance. He finds that these scales bear a segmental relation to the other hard and to the soft parts, and that they are either repeated consecutively, and in oblique rows corresponding to the segments, or they may be repeated in rows as multiples of the somites; there may, however, be segmental reduction which will affect the arrangement of the scales and reduce the number of rows. In the second place, the peculiar mode of interdigitation of the muscular somites, as indicated by the sigmoid outline of the myocommata, has developed a mode of insertion which has thrown the integument into rhombic areolæ during muscular contraction. These areolæ are in line in three directions, and the folds separating them are inflected in such a manner by muscular tension as to induce the condition of imbrication which is so characteristic of the squamation of many fishes.

* *Jenaische Zeitschr. f. Naturwiss.*, xxvi. (1892) pp. 297-468 (14 pls.).

† *Proc. Acad. Philadelphia*, 1892, pp. 219-24 (3 figs.).

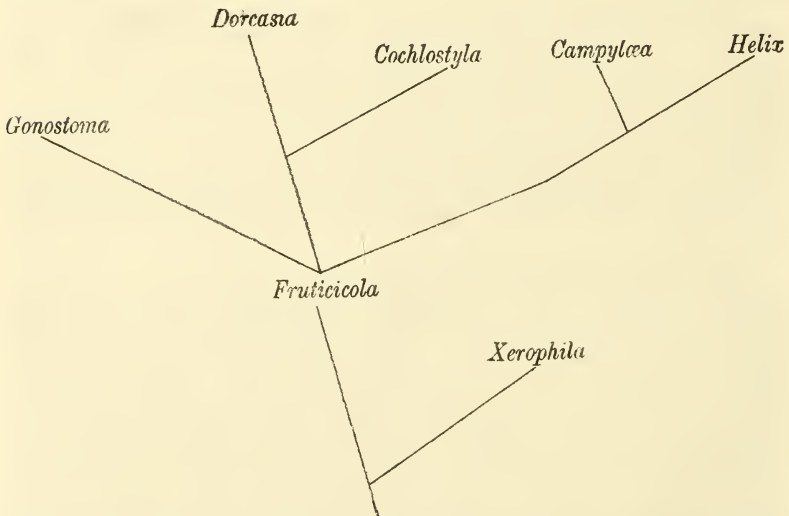
Commensalism between a Gymnoblasic Anthomedusoid and a Scorpænid Fish.*—Dr. A. Alcock finds that a fixed Hydroid (a species of *Stylactis*) and a highly locomotive animal (a fish of the genus *Minous*) have symbiotic relations. Never is either found without the other; if two species of the genus occur together the polyp selects *M. inermis*. The polyp (which is called *S. minoi*) gets the advantage of change of place, the fish has its appearance disguised.

B. INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Genital Apparatus of *Helix*.†—Dr. H. von Jhering devotes a lengthy memoir to the morphology and systematic value of the generative apparatus of *Helix*. He commences by reminding us that 3400 forms were enumerated by Pfeiffer in 1877, and that the various schemes that have been proposed for breaking up this huge group into smaller sections have been far from successful. He is himself convinced that a key is to be found in the genital system. He recognizes in the family Helicidæ seven well-marked genera which he arranges phylogenetically thus:—



With this statement we must content ourselves, as we must devote the space at our disposal to the author's speculations as to the phylogeny of the Nephropneusta. He thinks it so clear that the order Pulmonata is a zoological error that it is unnecessary to enter on a discussion of the question. The Branchiopneusta form an independent group

* Ann. and Mag. Nat. Hist., x. (1892) pp. 207-14 (1 fig.).

† Zeitschr. f. Wiss. Zool., xlv. (1892) pp. 386-520 (2 pls.)

allied to the Tectibranchiata, and have no closer relations to the Nephropneusta than the latter have to the Tectibranchiata. The fundamental error which led to the formation of the group Pulmonata is the comparison of the higher forms of the two orders which are united in it. Now that we know the mode of development of the Nephropneusta in its general lines we see that when we compare the lowest Branchiopneusta with the Nephropneusta the agreement is very slight and quite general.

An important point, hitherto noticed only by P. Fischer, is that we have learnt to distinguish the primarily naked Nephropneusta from those that are secondarily naked. The former or Meganota are chiefly represented by the Peroniidæ and the Vaginulidæ. In *Peronia*, as in all the marine naked Mollusca, the shell is only a larval organ. This larval shell is continued on to the adult stage in no Nudibranch, though it is in some Saccoglossata, and in nearly all Tectibranchiata; in this way it happens that naked and shelled forms may be found in the same family.

There are many difficulties in the way of a direct derivation of the Nephropneusta from the Tectibranchiata, but there are many signs of their having had a common origin in some primitive form, unknown to us. It is of importance to take note of the developmental series among the Nephropneusta as well as genetic relations to other Ichnopoda.

If we follow up this series we see that it is impossible to continue to allow the existence of an order Pulmonata. The author directs attention to the value of a research into the homologies of the spiculum amoris, and the demonstration of the absence of a receptaculum seminis in certain Nephropneusta; a study of the homologies of the penis and its retractors in the Nephropneusta will, with the other lines of investigation, show that a family of Helicidæ must be separated from a number of snail-like Mollusca, which have hitherto been associated only because of the characters of their shells; this family can be broken up into genera in a way which the conchologist will allow to be natural.

Morphology of Prosobranchiata.*—Dr. B. Haller describes in detail the anatomy of Naticidæ and Calyptræidæ. As regards fore-gut and a portion of the kidney, the Naticidæ recall the more primitive conditions found among the Tænioglossæ; as regards gills and the state of the visceral sac in *Sigaretus* they approach the Calyptræidæ—an aberrant group with adaptations for life among the rocks. As regards the genital apparatus, a portion of the kidney, and especially the nervous system, *Natica*, *Sigaretus*, and the Marseniidæ are related to the Rhachiglossæ. There seems no doubt as to the derivation of Calyptræidæ from *Sigaretus*. The genera *Crucibulum* and *Calyptræa* must be held as representing a younger form than *Crepidula*, *Ergæa*, and *Janacus*, but they are somewhat divergent from the main line. Partly on the strength of his own studies, partly on account of Bouvier's, Haller believes that the Tænioglossæ, derived from Architænioglossæ (*Cypræa*, *Cyclophorus*, *Paludina*), must be divided into two great groups—Brevicommissurata (more or less holostomatous) and Longicommissurata (siphonostomatous). The new terms refer to the cerebro-pedal and

* Morphol. Jahrb., xviii. (1892) pp. 451-543 (7 pls., 2 figs.).

cerebro-pleural commissures. The general scheme of classification suggested is as follows:—

Group Tænioglossæ.

I. Sub-group. Architænioglossæ (allied to Rhipidoglossæ).

1. Fam. Cyclophoridæ. 2. Paludinidæ. 3. Cyprææ.

II. Sub-group. Neotænioglossæ.

1. Subdivision.

N. brevicommissurata.

1. Littorinidæ (allied to *Bythinia*).
2. Neurobranchia.
3. Valvatidæ.
4. Ampullaridæ.
5. Melanidæ.
6. Cerithidæ.
7. Pyramidellidæ.
8. Turritellidæ.
9. Vermetidæ.
10. Entoconchæ.
11. Onustidæ.

2. Subdivision.

N. longicommissurata.

1. Tritonidæ.
 2. Dolidæ.
 3. Strombidæ.
 4. Pteroceridæ.
12. Naticidæ (Operculata, *Natica*; Anoperculata, *Sigaretus* and *Marseniadæ*).
 13. Calyptræidæ, including in serial order *Galerus*, *Trochita*, *Crucibulum*, *Crepidula*, *Ergæa*, *Janacus*.
 14. Cyclomyaria (Capulidæ and Hipponicidæ).

Anatomy of Siphonaria.*—Dr. B. Haller finds that *Siphonaria gigas* Less. is not a Pulmonate, but an Opisthobranch modified in adaptation to life among the rocks, with its nearest relative in *Umbrella*. It is a very old form of Pleurobranch, with many primitive characteristics:—the state of the nervous system, the double kidneys, the simple gonads, the row of gills and the double branchial veins. It is divergent in adaptation to a special habitat, and may be taken as type of a distinct family of Tectibranchiata which the author designates Semicyclobranchs.

Alleged Anal Eye of Larval Opisthobranchs.†—Dr. G. Mazzarelli discusses the organ which Lacaze-Duthiers and Pruvot described in 1887 as an anal larval eye. It had been previously described by several zoologists, most of whom had regarded it as glandular. Langerhans and Ray Lankester had interpreted it as a kidney, Trinchese as an anal gland, and so on. Lacaze-Duthiers and Pruvot regarded it as ectodermic, Trinchese as mesodermic, Lankester as endodermic. The organ in question is a pyriform vesicle containing pigment. Its anatomical occurrence, its included concretions, its development show that it is not an eye, but certainly a kidney. Thus all the dilated portion and part of the neck is mesodermic; only the distal end of the neck is ectodermic. "The alleged 'anal eye' of larval Opisthobranchs is in point of fact the permanent kidney."

* Arbeit Zool. Inst. Univ. Wien (Claus), x. (1892) pp. 71-100 (3 pls.).

† Atti (Rend) R. Accad. Lincei (1892) pp. 103-8.

Respiratory Globulin in Blood of Chitons.* — Dr. A. B. Griffiths has found in the blood of Chitons a respiratory globulin, which has no metallic constituent, though possessed of the same power of oxidation and reduction as hæmoglobin and other bodies. When charged with oxygen it is colourless. The author proposes to call it β -achro[*o*]globine to distinguish it from the achroglobin of *Patella*.

Anatomy and Histology of *Proneomenia Sluiteri*.† — Herr J. Heuscher has a preliminary notice of the results of his observations on this archaic Mollusc. In the integument there is a thin hypodermis and a greatly developed cuticle. The former consists of a single layer of small cubical cells, among which there are groups of eight to ten cells, which form small goblet-shaped glands and secrete cutaneous spicules. In the cuticle there are, at regular distances from the hypodermis, three or four layers of these goblet-glands, all of which are connected with the hypodermis by a thin peduncle. As we pass from within outwards we find larger calcareous spicules in each layer. In the outer half the spicules cease to have any connection with their matrix, but are still regularly arranged. Other glands, which Hubrecht did not see, are also present in large numbers in the cuticle; they form a secretion, part of which is lost in the cuticle, while part is discharged on the surface, and probably cements the detritus which is found firmly attached to the animal. Similar glands have been observed in other *Neomeniæ*.

The author thinks that the pair of pouches which Hubrecht regarded as the byssus, and which are pretty thickly filled with long calcareous needles, are, perhaps, organs which have a holding or stimulating function during copulation. The cup-shaped depression above the cuticle, though agreeing in position with an organ found in other *Neomenians*, differs in structure; it does not contain either the lamelliform spicules or tactile setæ described by Pruvot. The musculature of the body-wall recalls that of Annelids, and muscular septa appear to divide the body into segments. Hubrecht was inclined to distinguish an anterior from a posterior foot-gland on account of differences in reaction, but the author finds differences in reaction along the whole of the foot, and believes that they are merely due to variations in secretory activity.

Except in some points of detail, Hubrecht's account of the nervous system is accepted as correct. The dorsal blood series is found to be merely a lacuna between the suspensory muscles of the hermaphrodite gland; the ventral sinus is in free connection with the lacunæ which lie above the "septum." Respiration appears to be effected by means of the digestive canal; the papilliform processes which Hubrecht supposed to be gills are regarded as sensory organs; the radula is of the opisthobranchiate type. The filamentar glands connected with the reproductive apparatus, to which no function has yet been assigned, except by Pruvot, who regards them as representing a shell-gland, are, so far as the terminal portion is concerned, thought to be certainly such.

* Comptes Rendus, cxv. (1892) pp. 474 and 5.

† Vierteljahrschr. Naturf. Gesell. Zürich, xxxvii. (1892) pp. 148-61 (4 figs.).

Land Mollusca of the Philippine Islands.*—The Rev. A. H. Cooke examines the problem of the ancient relationship of the different islands of the Philippine group to one another by the aid of the almost peculiar genus *Cochlostyla*, which is exceedingly rich in species; he also discusses the relations of the Philippines to the neighbouring islands.

δ. Lamellibranchiata.

Classification of Lamellibranchs.†—Prof. C. Grobben proposes the following classification of Lamellibranchs.

Sub-class I. PROTOBRANCHIATA; With double comb-like gill, no teeth to shell, or interdigitating denticles or taxodont—Vlastidæ, Cardiolidæ, Antipleuridæ, Lunulicardiidæ, Præcardiidæ, Siluriniidæ, Protomyidæ, Solenopsidæ, Grammysiidæ, Posidonomyidæ, Dionellidæ, and Nuculidæ.

Sub-class II. DESMODONTA; With double-leaf-like gills; teeth absent or irregular—Pholadomyidæ, Myidæ, Anatinidæ, Panopæidæ, Septibranchia, Mactridæ, Pholadidæ, and Gastrochænidæ.

Sub-class III. AMBONODONTA; With double-leaf-like gills; teeth marginal indentations of the shell, alternate; may be wanting.

1st Order, Eutaxodonta: Arcidæ.

2nd „ Heterodonta: Astartidæ, Crassatellidæ, Charonidæ, Lucinidæ, Cardiidæ, Tridacnidæ, Cyrenidæ, Cyprinidæ, Veneridæ, Solenidæ, Tillinidæ, and Donacidæ.

3rd „ Schizodonta: Trigonidæ, Najades.

4th „ Anisomyaria: Aviculidæ, Mytilidæ, Pinnidæ, Pectinidæ, Spondylidæ, Ostreidæ, and Anomiidæ.

Some comparisons between this system and those recently proposed by Neumayr and B. Sharp are made.

The Mantle-margin of Acephala.‡—Dr. B. Rawitz continues his study of the mantle-margin, describing that of Lucinacea (*Cardita*, *Astarte*, *Lucina*); *Dreissenia polymorpha*; Veneracea (*Cardium*, *Cyprina*, *Artemis*, *Cytherea*, *Venus*, *Tapes*, *Petricola*); Tellinacea (*Donax*, *Psammodia*, *Tellina*); Myacea (*Solecurtus*, *Solen*, *Lyonsia*, *Mactra*, *Mya*); Pholadacea (*Teredo* and *Pholas*). Of the multitudinous histological details which he describes we shall not attempt to give a summary. A special chapter is devoted to the epicuticula, which is thin, structureless, and transparent in Arcacea and Ostreacea, but shows in other orders an increasing thickness, opacity, and complexity. In *Arca* and *Pecten* it is only a very small portion of the marginal epithelium which forms the epicuticula, in Mytilacea a larger region is implicated, and in the Siphoniata much more; in the last-named forms the layer is complex and two-layered. In some Myacea not only the folds of the mantle-margin, but the epithelium of the whole external surface of the siphon form an epicuticula, which is formed precisely in the way that Huxley described in the case of the chitinous covering of the crayfish.

* Proc. Zool. Soc., 1892, pp. 447-69.

† Zool. Anzeig., xv. (1892) pp. 371-5.

‡ Jenaische Zeitschr. f. Naturwiss., xxvii. (1892) pp. 1-232 (7 pls., 5 figs.).

Dr. Rawitz also discusses the relation between sensory and secretory functions in the mantle-margin, and concludes that the differentiation of specific sense-organs is in inverse ratio to the glandular activity. Finally he emphasizes, not without cause, the necessity of distinguishing between the manner in which some animals are influenced by light and the manner in which others have sensations of light or it may be visual perceptions. Pigment-spots and pigment-cells have no sensations of light, far less power of sight, therefore it is unwarrantable to speak of them as "primitive optic organs."

Molluscoida.

α. Tunicata.

Development of Stigmata in Ascidians.* — Mr. W. Garstang attempts to offer an aid to the solution of the problem which renders so difficult a comparison of the stigmata of fixed Ascidians with those of their pelagic allies. At the outset he found himself disinclined to accept the generally received view that the pelagic Caducichordate Tunicata have been derived from the so-called Compound Ascidians, and he studied, therefore, the development of the stigmata of the latter in the hope that in them recapitulative stages would be met with. Mr. Garstang has investigated *Clavelina*, and has nothing to add to or alter in Seeliger's account published seven years ago. In *Botryllus* the two modes of development which are known to occur in Ascidians are to be seen; the stigmata in the oozoid arise by the subdivision of protostigmata, while the stigmata of the buds arise quite independently; the term "protostigma" is new and is given to the transversely elongated primary stigmata. It must, of course, be supposed that the larva exhibits a more primitive mode than the bud, and the author thinks that it may be safely assumed that the protostigmata of Ascidians arose primitively in regular order from before backwards. It is very significant that in *Pyrosoma* the phylogenetic inferences which have been drawn from the development of the stigmata in Ascidians are exactly fulfilled; in it the stigmata are arranged in a single longitudinal series along each side of the pharynx, and they are transversely elongated, from the dorsal surface to the endostyle. They, therefore, resemble precisely, both in form and in arrangement, the protostigmata of larval Ascidians. The author submits, therefore, that we have in *Pyrosoma* a primitive type of Caducichordate Tunicata, which is antecedent to the whole of the phylum Ascidiacea, and which exhibits very closely the ancestral form of pharynx from which the complicated respiratory organ of the fixed Ascidians has been derived.

If this view is accepted it will follow that *Clavelina* and its allies must no longer be regarded as the most primitive members of the Ascidiacea, and that *Botryllus* and the Styelinae must take this position.

Developmental Cycle of Compound Ascidians.†—Dr. J. Hjort finds that the whole rudiment of the buds of Botryllidæ consists, as in the Bryozoa, of two epithelial lamellæ of ectodermal origin with mesodermal cells scattered in them. From this it follows that the gemmation of

* Proc. Roy. Soc. Lond., li. (1892) pp. 505-13.

† Zool. Anzeig., xv. (1892) pp. 328-32.

the Botryllidæ differs so far from that of other Ascidians, such as *Perophora*, *Didemnum*, or *Distaplia*, that the inner vesicle is always, directly or indirectly, formed from the endoderm. The intestinal tract, the peribranchial vesicle, and the nervous system are given off from this inner vesicle.

The process by which the peribranchial vesicle is formed begins with the formation from the ventral wall of the internal vesicle of folds which project into its interior; a median vesicle is thus formed, which communicates by two orifices with the two lateral peribranchial vesicles. The first rudiment of the nervous system is a hemispherical evagination which appears at about the middle of the dorsal wall of the median vesicle. A tube which opens by both ends into the median vesicle soon appears, and this becomes thickened on its ventral side; it becomes more and more cut off from the dorsal portion of the tube, and fine fibres are formed in its interior. The thickening becomes the permanent ganglion, while the tube, which gets longer and thinner, persists as the hypophysis. The author's results are by no means in accordance with those of Seeliger or Salensky.

In the study of compound Ascidians, Dr. Hjort has discovered several points of agreement between gemmation and larval development. In the cerebral vesicle of *Distaplia magnilarva* there is, at an early stage, a difference between the left and right sides. From the right there arises an outgrowth which soon exhibits the most various differentiations, and from which the larval brain arises; the left side continues to retain the indifferent character of its cells. The anterior part of the brain-vesicle becomes fused with the enteron, and later, becomes perforated and so forms, during the whole of the larval period, a communication between the enteron and the brain-vesicle. The multilaminar left wall of the vesicle becomes thickened at about its middle to form the permanent ganglion, and this thickening is more and more constricted off. The left wall elongates and represents the so-called ciliated pit. While the larval brain, which is formed by evagination from the right wall of the cerebral vesicle, is being constricted off, the epithelioid left wall of the primitive brain-vesicle forms a tube which is a direct continuation of the ciliated pit, and is regarded as the hypophysis.

We find, therefore, that in both larval development and gemmation the hypophysis and the persistent ganglion have a common origin; this is, in both modes of development, tubular, and in both cases the ganglion is formed as a thickening of the tube. The larval brain-cavity opens, as Kowalevsky asserts and van Beneden and Julin deny, by the hypophysis into the enteron. In the adult developed from the larva the lumen of the hypophysis is the only part of the lumen of the larval brain-vesicle which is persistent.

Development of Hypophysis in Ascidians.*—Mr. A. Willey, who has come to similar results as Dr. J. Hjort (see *suprà*) with regard to the development of the hypophysis in Ascidians, has a preliminary notice of his researches. He has worked with *Ciona intestinalis* and *Clavelina lepadiformis*. He supports Kowalevsky, as against Van Beneden and

* Zool. Anzeig., xv. (1892) pp. 332-4 (1 fig.).

Julin, in asserting the presence of a communication between the nerve-tube and the stomodæum. Before the cerebral vesicle of the Ascidian larva atrophies a portion of its wall becomes constricted off from the vesicle as a tube which opens in front into the mouth, while behind it is continuous with the rest of the neural canal. Van Beneden and Julin are in error in supposing that the hypophysis is a thing apart from the neural tube; they are at first one and the same, and it is only at a later period that the definitive hypophysis and the ganglion become differentiated and separated from one another. The ganglion of the Ascidians seems to bear the same relation to the hypophysis, that the infundibulum does to the hypophysis of the higher Vertebrates; the difference is that in the latter these parts are rudimentary and arise independently, while in the former both organs are functional and arise together.

Eyes of *Salpæ*.*—Prof. O. Bütschli reports that the simplest eye of a *Salpa* has the form of a single dorsal eye which forms a moderate projection; it is chiefly composed of a retina, the cells of which are arranged radially to the surface. At the basal periphery there is a zone of pigment-cells which may certainly be said to have arisen by differentiation of the cells of the embryonic ganglion, just like the retinal cells. The latter, as in all eyes of *Salpæ*, are composed of two kinds of cells, some of which are truly optic while others are supporting; the latter are seen, in sections, to form a kind of network in the interspaces of which the optic cells are set. This simple eye receives its nerve-fibres directly from the brain, so that the free ends of the optic cells are turned towards the light.

In other cases there is a certain differentiation of the eye, for the lateral parts of the retina begin to press outwards, and their nervous supply becomes somewhat altered. This differentiation of the primitively simple eye into three parts, a median and two lateral, may be very well seen in those forms in which the eye is converted into a horse-shoe-shaped ridge, open anteriorly, and placed on the dorsal side of the ganglion. The median part has the same minute structure as in the already described simple eye; but the retinal cells of the lateral parts tend more and more to take up a position perpendicular to that which they originally held. Their nerve-fibres are, consequently, distorted and form a plexus, and their pigment now occupies the outer end of the retinal cells. As a result of this, the median part of the eye has the ordinary character of a non-inverted eye, while the lateral parts have become inverted parts. This is very well seen in other *Salpæ*, where the three parts have become sharply differentiated from one another, and where they form three eyes on the anterior end of the brain.

The author justly remarks that this change is remarkable, and the fact has certainly a deep morphological and phylogenetic significance. It is difficult to compare the simple Salpan eye with the pineal eye of Vertebrates, unless we suppose that it was covered by a very delicate membrane, which was continued peripherally into the zone of pigment-cells. If we may suppose that this eye was primitively vesicular we could understand the connection between it and the vesicular eyes of Vertebrates, where the brain itself remains hollow. The

* Zool. Anzeig., xv. (1892) pp. 349-53 (5 figs.).

cleft which is seen during the development of the lateral Vertebrate eye may be explained by supposing that the eye had not at first the form of the optic vesicle, but that it was a flattened vesicle, one lateral wall of which became the retina, and the other the layer of pigment epithelium. It was not till later, when the primitively absent lens became developed, that the flattened optic vesicle became the optic cup. In this outgrowth of the margins of the flat vesicle we find an explanation of the cleft.

Post-Embryonic Development of *Ciona* and *Clavelina*.* — Mr. A. Willey gives a preliminary account of his observations on the post-embryonic development of *Ciona intestinalis* and *Clavelina lepadiformis*. He finds that the former presents much more primitive features than the latter, and he proceeds to compare the conditions in *Ciona* with those of *Amphioxus*.

The proboscis cavity of *Amphioxus* is lined by a flat epithelium, as is the rest of the body-cavity; in *Ciona* the proboscis cavity contains loose endoderm-cells in place of an epithelium, as does the rest of the body-cavity; but the distinction between mesoderm and mesenchym is no longer generally recognized as fundamental.

In instituting any comparison between Ascidians and *Amphioxus* the endostyle should be taken as the starting point, and the fact should be remembered that its primary axis is perpendicular to its definite axis in both cases. Making allowance for the secondary change of position which the mouth has undergone in the larva of *Amphioxus*, it is found that the relative position of the various organs from before backwards is precisely the same in *Ciona* and *Amphioxus*, viz. (1) proboscis-cavity, (2) endostyle, (3) mouth, (4) first pair of gill-slits.

The author submits the following table of homologies:—

<i>Ascidians.</i>	<i>Amphioxus.</i>
(a) Proboscis-cavity	= Proboscis-cavity and præoral pit.
(b) Endostyle	= Endostyle.
(c) Mouth	= Mouth.
(d) 1st pair of gill-slits (proper)	= 1st pair of gill-slits.

If these views be correct it is impossible to accept the homology of the club-shaped gland of *Amphioxus* with the intestine of Ascidians, which has been suggested by van Beneden and Julin, while they make the relations between the two types less strained than they were on the views previously entertained.

Formation of Mantle in Ascidians.†—Prof. A. Kowalevsky finds from a study of *Phallusia* and other forms that the mantle-cells migrate from the mesoderm into a superficial mucous layer. There they probably serve to increase the tunic-substance, but seem also to act as phagocytes both in relation to bacteria and in cases where individuals are moribund. The author also describes a number of sections bearing upon doubtful points in the morphology of Tunicates.

A Functional Hermaphrodite Ascidian.‡—Prof. W. A. Herdman has observed a large Ascidian (probably *A. rubicunda*) expelling eggs

* Proc. Roy. Soc. Lond., li. (1892) pp. 513-20 (3 figs.).

† Mém. Acad. Imp. Sci. St. Petersb., xxxviii. (1892) pp. 20 (2 pls.).

‡ Nature, xlv. (1892) p. 561.

from the atrial aperture. Immediately after each set of eggs there came a little white milky jet, which, on examination with the Microscope, was found to be a mass of active spermatozoa. After two hours segmenting ova were found at the bottom of the dish which contained the Ascidian. It is possible that this self-fertilization occurs in some other species, though not in all.

β. Bryozoa.

Gland-like Bodies in Bryozoa.*—Mr. A. W. Waters has found gland-like bodies in the avicularian chamber of various Bryozoa, but has studied them most satisfactorily in *Lepralia foliacea*, where he has observed them to be composed of small elongate cells, which are in some cases distinctly nucleated. Suboral glands are now known in a number of species, though they are by no means found in all. The present results are not complete, as the author has not yet been able to trace the early stages of these structures.

γ. Brachiopoda.

Development of Brachiopoda.†—Mr. C. E. Beecher gives a brief review of the known embryology of the Brachiopoda in the nomenclature of the stages of growth and decline which has been proposed by Hyatt; the author desires to account for some of the differences presented by adult forms in the several divisions of the class, but our knowledge does not appear to be so complete as to enable him to come to any important generalizations.

Arthropoda.

α. Insecta.

Appendages of First Abdominal Segment of Embryo Insects.‡—Mr. W. M. Wheeler applies to these organs the name of pleuropodia for the purpose of suggesting their origin from foot-like organs, and their tendency, when fully developed, to take up a position on the pleural wall of the embryo. Summarizing his own results and those of other observers, he concludes that pleuropodia were at one time organs of considerable functional importance to the primitive Hexapoda. This is not only proved by the size to which they sometimes attain, as in *Blatta*, but by the variety of structure which they exhibit. In some orders they appear to be of constant occurrence, while in the Lepidoptera and Hymenoptera they are as constantly wanting; they are always derived from the ectoderm, and arise as appendages, which are serially homologous with those of the thorax and abdomen. Sometimes they are formed by invagination, sometimes by evagination, and there are numerous varieties of form. The cells and nuclei of which they are composed increase in size, and usually become more succulent than other ectoderm cells; they contain one or two cavities. No tracheæ, nerves, or muscles have been observed to enter into their composition; a few mesoderm-cells, which are probably blood-corpuscles or fragments of mesenchymatous tissue, have been seen in the cavities of some pleuropodia.

In some species the pleuropodia produce a secretion from the ends of their enlarged cells, which may be a glairy albuminoid substance, a

* Journ. Linn. Soc. Lond., xxiv. (1892) pp. 272-8 (1 pl.).

† Amer. Journ. Sci., xlv. (1892) pp. 133-55 (1 pl.).

‡ Trans. Wisconsin Acad., viii. (1892) pp. 87-140 (3 pls.).

granular mass, a bundle of threads, or a thick, striated, cuticula-like mass. The constriction seen in some pleuropodia is probably homologous with one of the constrictions which separate the thoracic and maxillary appendages into segments. In some cases, at least, no chitinous cuticle is formed over the surface of the pleuropodial cells. These organs attain their greatest development during the revolution of the embryo, but soon after the yolk has been enclosed by the body-walls, and the heart has formed, they begin to degenerate. This degeneration does not always result in a reabsorption into the body of the embryo, but in a falling asunder of its large cells, and their subsequent dissolution outside the body of the Insect.

With regard to the function of these organs, it has been suggested that they are gills, sense-organs, or glands; the author, for reasons which he gives, is inclined to accept the third of these suggestions.

Scale-Pigments of Lepidoptera.*—Dr. F. Urech has investigated the various kinds of pigments found in the scales of some Lepidoptera, and arranges them under five heads; (i.) Scales which only contain chemical colouring matter, and can show no interference colours; (ii.) Those which contain chemical colouring matters, but are also able to show interference colours, as the scales of species of *Vanessa*; (iii.) Scales which only show interference colours on the wings, though they contain chemical colouring matters soluble in water, as species of *Lycæna*; (iv.) Scales whose coloration is due to the underlying layer, as the blue and violet scales of species of *Vanessa*; and (v.) Various coloured overlying scales often show mixed colours as in *Papilio Machaon*.

In the scales which show interference colours, two kinds may be distinguished; the colours are only visible when the scales are removed from the wing, and brought into definite relations to the rays of light; or the colours are visible on the wing if the scales are removed from the opposite side, and the wing held in certain positions. The second group of colours are visible in reflected light when the scales are on the wing, but they generally vary in two colours only, and that according to the position of the reflected light (e. g. *Apatura Iris*, and species of *Lycæna*.)

Green Pigment in Wings of Chrysalids of *Pieris brassicæ*.†—Dr. F. Urech finds this when the unexpanded wings have their scales carefully removed. If the young wing is placed in water the fluid is coloured; after evaporation there remains a deep-green membranous mass. This, on being again bathed in water, is not wholly dissolved, a pale portion remaining. Thus it seems that in the first solution some substance associated with the pigment is dissolved, which after drying becomes insoluble. It may be a substance which gives rise to the pigment, or it may be merely its bearer. The green pigment is not chlorophyll; nor is it identical with the scale-pigments, though perhaps representing a preparatory stage; nor is it the pigment of the blood.

Pupine.‡—Dr. A. H. Griffiths gives the name of pupine to a new substance which he has extracted from the skin of the pupæ of three

* Zool. Anzeig., xv. (1892) pp. 305-6.

† Zool. Anzeig., xv. (1892) pp. 281-3.

‡ Comptes Rendus, cxv. (1892) pp. 320-1.

species of *Picris* and three other Lepidoptera. It is colourless and amorphous, and is secreted by the pores of the larva after it has changed its skin for the last time. Its chemical formula is given as $C_{14}H_{20}N_2O_5$.

Development of Imaginal Eye of Vanessa.*—Herr H. Johansen describes the faceted eye as being derived from the unilaminar epidermis of the caterpillar, without the intermediation of any invagination such as has been described by Patten in the Wasp. The approximation of the epidermal cells to form the ommatidia occurs soon after the separation of the larval eye from the epidermis. The cavity of the cephalic vesicle contains a number of leucocytes as well as the destruction products of the larval organs. Thirteen cells primitively take part in the formation of one ommatidium; there are four cells whose nuclei were called Semperian by Claparède, two pigment-cells of the first order and seven reticular cells, as well as one ganglion-cell and six pigment-cells of the second order. The nuclei of the pigment-cells of the first order primitively lie above or distally to the Semperian nuclei; soon, however, the cells belonging to the latter secrete the corneal lenses and the crystalline-cone-segments. The cuticular hairs are products of cells which take no part in the formation of the ommatidia, but which may be regarded as the last remnants of the epidermal cells which were primitively present in larger numbers; they are indications that the phylogenetic development of the faceted eye of the Tracheata is due to an aggregation of single eyes.

The eye remains, apparently, unilaminar throughout its whole extent; the formation of the crystalline cone is not an external excretion in the sense of Claparède, but an internal secretion; within each of the four cells a morsel of cone substance is given off proximally from the "Semperian" nucleus. The rhabdom is not an excretion of the cells of the retinula, but a living modification of their protoplasm, and it is, therefore, not a process of the crystalline cone, as Patten suggested.

Pigment appears in all the cells of the faceted eye, with the exception of the distal ends of the crystalline-cone-cells and the hair-cells. The epidermal cells which become grouped into ommatidia receive a not inconsiderable amount of pigment from the eyes of the caterpillar, which is brought them by the leucocytes.

The optic ganglion of the imago is derived from that of the larva, and is not an absolute new formation like the epidermal part of the eye. The layer of nerve-bundles, however, appears to be a new formation as it takes its origin from two primitive nerve-bundles and arises by continuous centripetal cleavage of these. In the other layers of the optic ganglion these are merely processes of growth, in consequence of which the whole ganglion becomes much larger and fills up the head-cavity. Further descriptions, with illustrations, are promised.

Post-larval New Formation of Glandular Cells in Silkworm.†—Sig. E. Verson finds in the pupa stage under the hypodermis numerous

* Zool. Anzeig., xv. (1892) pp. 353-5.

† Bull. Soc. Entomol. Ital., xxiv. (1892) pp. 1-17 (1 pl.); Zool. Anzeig., xv. (1892) pp. 216-7.

"epigastric" glandular cells which arise from a local degeneration of the larval hypodermis. While the hypostigmatic glands already described appear before hatching, and persist throughout life, the epigastric cells do not appear until the time of cocoon-spinning. While the hypostigmatic cells remain numerically constant, the epigastric cells multiply abundantly by amitotic division during the period of pupation. And while the hypostigmatic cells have nuclei which show a characteristic tendency to branching, the epigastric cells have nuclei, which are always roundish and never have lateral processes.

Papillæ on Feet of Silkworm.*—Sig. E. Verson denies the correctness of Tichomiroff's observation that among the hooklets on the sole of the abdominal feet of the silkworm there is also an attaching papilla which secretes a viscid substance. There is no secretory activity, and the papilla is only a loose cuticular fold on whose lateral margins, at each moult, new hooklets are protruded. The feet may, however, act like suckers, and then the hooklets do not come into operation.

International Relations of *Lomechusa*.†—Herr E. Wasmann describes the treatment which *Lomechusa strumosa* F., a regular guest of *Formica sanguinea*, receives at the hands of various ants. The guest is also found in the homes of *F. rufa* and *F. pratensis*, and very rarely in the independent colonies of *F. fusca* and *F. rufibarbis*, species which are known to be slaves of *F. sanguinea*. It is a "true guest," often licked by its host, and fed like a larva. Technically it is one of the Aleocharinæ. Its larvæ are reared along with those of its host, although it eats the eggs.

When transferred to strange colonies of *F. sanguinea* the guest is at once received. Even when the new hosts are without any *Lomechusa* guests, the reception is a welcome. That there is a hereditary prejudice in favour of the guest is shown by the fact that quite young colonies of *F. sanguinea* receive *Lomechusa* with equanimity. Moreover, in most cases the helper-ants of *F. sanguinea* offer no objection to a new guest, nor seem to mistrust it in any way. For *F. sanguinea*, therefore, *Lomechusa strumosa* is a thoroughly international guest. The same seems to hold true, though not quite so perfectly, for *F. rufa*.

Antennary Structures in Ants.‡—Sig. S. Sergi describes three kinds of apparently sensory structures on the antennæ of *Formica fusca*, *Atta barbara*, *Lasius flavus*, and *Pheidole megacephala major* and *minor*. Sections showed no trace of nerve-fibres going to the organs in question, but the author believes that the central white substance in the antennæ may act like a nerve-cell. As to the function of the organs, no certain conclusions can be reached where experiment is almost impossible, but it is likely that the three structures are auditory, olfactory, and tactile.

American Estridæ with Larvæ living in the Human Skin.§—Dr. R. Blanchard gives an account of the larvæ belonging to four different species of the Dipterous genus *Dermatobia* which in the inter-

* Zool. Anzeig., xv. (1892) pp. 279-81.

† Biol. Centralbl., xii. (1892) pp. 584-99.

‡ Bull. Soc. Entomol. Ital., xxiv. (1892) pp. 18-25 (2 figs.).

§ Ann. Soc. Entomol. France, 1892, pp. 109-54 (12 figs.).

tropical zone of America, have been found living in the skin of Man. He points out that not one of them is peculiar to Man, and that, therefore, the old belief in an *Æstrus hominis* must be abandoned.

Digestive Tract of *Gryllotalpa vulgaris*.*—Herr J. Eberli has made a detailed examination of the digestive tract of this Insect, devoting most of his attention to the stomach; he finds that the four lamellæ which extend into the hind-gut are structures which arise from four longitudinal stripes in the stomach. There is no funnel in Schneider's sense in *Gryllotalpa*; the function which he ascribed to it is performed by the four lamellæ, and while these form a filter they serve as a protecting apparatus to the hind-gut. It is clear that the stomach is not to be regarded as a comminuting organ of the food; one of its functions is to aid the passage into the sacculæ of the mid-gut of nutrient particles which have been finely divided by the chitinous denticles.

The hind-gut is much longer than the first two portions, and may be divided into four subdivisions; there is an infundibular portion which narrows posteriorly, a second which is much wider and receives the openings of the Malpighian vessels, there is a third narrower piece and a wide rectum.

Spermatogenesis in *Gryllotalpa*.†—Dr. O. vom Rath describes the spermatogenesis of *Gryllotalpa vulgaris* Latr., and pays particular attention to the question of "reduction-divisions." The important point is that in the sperm-mother-cell at the beginning of the second last division the number of chromosomes is double the typical number; in the second last division the doubled number is reduced to the normal, and in the last division halved. The result was confirmed by observations on *Hydrophilus*, *Astacus*, *Branchipus*, and various Copepods, &c. It supplies an additional basis of fact for Weismann's conclusions.

Anatomy of *Phylloxera*.‡—Herr J. Krassiltschik has some preliminary notes on the structure of *Phylloxera vastatrix*, describing especially a complex salivary pump which he has discovered, and also discussing the precise mechanism of sucking. The minute dorsal tubercles, the retort-shaped organs discovered by Metschnikoff, the musculature, the fatty tissue, and the pseudovitellus whose cells are scattered in small groups in the fatty tissue, are also noticed; and the close relationship of *Phylloxera* to Coccidæ is maintained.

Oral Appendages of *Thysanura* and *Collembola*.§—Rudolph Ritter von Stummer-Traunfels describes these in *Japyx*, *Campodea*, and *Collembola*, interpreting them as (1) mandible, (2) maxilla (without galea or palp), and (3) labium, with palp, and including ligula and paraglossæ. In *Japyx* and *Campodea* there are inner and outer paraglossæ, the latter with palp; in the *Collembola* there are only the inner paraglossæ, the outer having fused with the palp. After a comparison of the above-mentioned forms with those of *Machilidæ* and *Lepismidæ*, the author notes the essential uniformity throughout the order, which he divides

* Vierteljahrsh. Naturf. Gesell. Zürich, xxxvii. (1892) pp. 167-212 (10 figs.).

† Archiv f. Mikr. Anat., xl. (1892) pp. 102-32 (1 pl.).

‡ Zool. Anzeig., xv. (1892) pp. 217-23 (1 fig.).

§ SB. K. Akad. Wiss. Wien, c. (1891) pp. 216-35 (2 pls.).

into two sub-orders, Entognatha (Campodeidæ, Japygidæ, Collembola) and Ectognatha (Machilidæ and Lepismidæ).

γ. Prototracheata.

Peripatus in Jamaica.* — Messrs. M. Graham and T. D. A. Cockerell report the rediscovery of *Peripatus* in Jamaica; the species is considered to be identical with that found by Grube many years ago; it is very closely allied to *P. Edwardsi* as described by Mr. A. Sedgwick, but has a larger number of legs. The authors propose to call it *P. jamaicensis*, and fuller details are promised.

δ. Arachnida.

Liphistius and the Classification of Spiders.†—Mr. R. I. Pocock proposes to divide the Araneæ into the two groups of the Merothelæ and the Opisthohelæ; the former will contain *Liphistius* only, in which the spinning appendages retain their embryonic position in the middle of the lower surface of the abdomen, whereas in the latter these appendages migrate to the posterior end of the abdomen. Other points of distinction are — the Merothelæ have eight, the Opisthohelæ never more than six spinning mamillæ; in the former there are on the upper surface of the abdomen nine distinct tergites and on the lower two distinct sternites, while the latter have no distinct tergal plates to the abdomen, and the abdominal sternites persist only as the pulmonary opercula and the epigyne.

Liphistius, therefore, appears to be a transitional form between the Opisthohelæ and the Phrynidæ, and it retains embryonic characters which all other Spiders lose. It would appear, also, to possess the homologue of the cribellum, and if so, its presence in widely different genera of other Spiders can be easily explained, and the possession of this organ loses the importance ascribed to it by Bertkau and Simon. Similarly, the fact that *Liphistius* has three well-developed claws to the feet, may explain the fact that genera of the Opisthohelæ which are not naturally allied may appear to be so by having three or two claws.

Mr. Pocock, therefore, proposes to divide the Opisthohelæ into the Mygalomorphæ (Aviculariidæ and Atypidæ) and the Arachnomorphæ (Hypochilidæ, Dysderidæ, and others), and to distinguish them thus; in the former the plane of the joint of the mandible with the cephalothorax is nearly vertical, while in the latter it is nearly horizontal; in the latter the posterior lung-sacs are nearly always replaced by tracheal tubes, and they have six spinning mamillæ, whereas the Mygalomorphæ have ordinarily four.

Observations on a Scorpion.‡—Herr C. Grevé gives an interesting account of a scorpion (*Centrurus biaculeatus* Lucas) from Central America, which came to Moscow encased in a wood-block. He kept it alive from September until May, and watched its movements, its occasional seizure of a cockroach, its thirst for water, its attempts to sting, the subsequent fatigue, and so on. For a short time Herr Grevé also kept the larva of one of the Blattidæ (unidentified) from the same source.

* Nature, xlvi. (1892) p. 514.

† Ann. and Mag. Nat. Hist., x. (1892) pp. 306-14.

‡ Zool. Jahrb., vi. (1892) pp. 461-4.

It fed on water-melons. The author laments that the manufactory, to which the wood with its far-travelled inmates came, now employs a machine for cutting up the blocks, hence he will receive no more "blinde Passagiere."

Development of Mites.*—Herr J. Wagner has found *Ixodes* a suitable object for the study of development, as the process is pretty slow and the eggs do not require much care. The segmentation of the egg differs from that of other mites hitherto observed in that the cleavage process belongs to the type of partial intercellular segmentation. Later on the cells pass to the surface and form the blastoderm. Some of the cells are distinguished by their large nuclei, which ordinarily do not lie parallel to the surface of the egg; these nuclei are stained by carmine more feebly than those of the ordinary blastoderm-cells, and they contain one or two distinct nucleoli which are not present in the nuclei of the other cells. These cells retreat from the surface to the interior of the yolk, and the blastoderm-cells which surround them close together over them; they form the so-called yolk-cells. Some of them become heaped into a mass which forms part of the endoderm.

At the side of this endodermal mass the mesoderm cells become apparent; on either side of the mass there is in the early stages of the development of the mesoderm a superficial groove-like depression, at the base of which there is a steady immigration of cells. These depressions appear to correspond with the lateral margins of the germ-stripes of Insects.

During the cleavage of the egg no division of the yolk is to be observed. When, however, the appendages are being formed, the yolk loses its homogeneous appearance, and breaks up into several polygonal pieces, separated from one another by clefts. Later on this appearance is still more marked.

The germ-stripe of Mites, as of Spiders, occupies, during the stage of the appearance of the appendages, the greater part of the circumference of the egg; in this stage it consists of two ectodermal ridges which are separated by a band of flat cells, and meet at the ends of the elliptical egg. Looked at from the side, the extremities are seen to be very sharply marked off. In addition to the ordinary and characteristic three pairs of legs a fourth pair appears; this, after showing signs of undoubted segmentation, begins to suddenly retrograde shortly before the extrusion of the larva, so that soon there is no sign of the pair left. Sections, however, of the larva show that there is an aggregation of cells which form the remnant of the fourth pair of legs. It is from this mass of cells that the fourth pair of limbs appear to be developed, when the larva passes into the nymph.

The author concludes with a short account of the segmentation of the abdomen and the extremities of the head. Behind the appendages there are five or six mesodermal groups; the mesoderm is best developed in the second, third, and fourth segments, in each of which a slight protuberance makes its appearance; these are undoubtedly homologous with the abdominal extremities of Spiders. There are no rudiments of any extremities in front of the chelicerae, but between them and the

* Zool. Anzeig., xv. (1891) pp. 316-20.

pedipalps there is in the early stages of development a pair of slight protuberances; later on they disappear altogether.

Relations of Acaridæ to Arachnida.*—Mr. H. M. Bernard brings forward evidence to show that the “degeneration” of the Acaridæ from the Arachnidan standpoint “is almost purely quantitative, not qualitative.” In other words he regards them as Arachnids permanently fixed at a larval stage of development. *Tetranychus tiliarum* is a rather primitive form which retains its segmentation, but seven segments found in other Arachnids are missing, and so far it seems to be a fixed larval form. The primitive nature of this Mite is further spoken to by its mouth-organs. Taking these and other facts the author urges that the Acaridæ are Araneids fixed at a larval stage because of the many advantages which animals of such small size have over larger ones and on the following grounds:

(1) On comparing the segmentation of a simple form of Acarid with that of an Araneid, seven abdominal segments in front of the anal are seen not to be developed, but those that are can be easily homologized with a similar number of anterior segments of an Araneid.

(2) It is clear that it is the abdominal part of the alimentary canal of the Araneid that is wanting in the Acarid.

(3) The heart of *Gamasus* appears to be an Araneid heart arrested in its development, and the abdominal extension is the part that is wanting.

(4) The only important difference in the ventral ganglionic masses is due to the greater development of the abdomen in the Araneid.

(5) The large size of the eggs of Acarids seems to show that, while the animal has diminished in size, the eggs have retained more nearly the size of those of the original adult forms.

(6) While the Araneids have book-leaf tracheæ confined to the abdomen, the Acarids have purely tubular tracheæ confined to the thorax.

Mr. Bernard adduces some objections to the theory of the gill-origin of tracheæ, and urges that, if we sever the Arachnida from the Tracheata, it will be necessary to assume four more or less distinct origins for the tracheæ.

Excretory Organs of Pantopoda.†—Prof. A. Kowalewsky points out that the uncertainty which exists among naturalists as to the correct systematic position of the Pantopoda makes every addition to our knowledge of their structure interesting. His investigations commenced with staining the organs during life, but the only reagent which was found to act quickly is acid fuchsin, and the genera chiefly studied were *Ammonothea*, *Pallene*, and *Phoxichilus*.

In *Phox. vulgaris* the glands, which lie in the body-segments, form pretty compact organs, but exhibit considerable individual variations in position and number. The author describes his sections, which he figures, and to which he refers in such a way as to make any general review impossible. For the present he abstains from offering any generalizations.

* Journ. Linn. Soc. Lond., xxiv. (1892) pp. 279-91 (1 pl.).

† Mem. Acad. Imp. St. Petersburg, xxxviii. No. 12, 9 pp. (1 pl.).

Anatomy of *Pentastomum teretiusculum*.*—Prof. W. Baldwin Spencer has published a detailed account of the anatomy of this parasite, which was taken from the lung of the copper-head snake (*Hoplocephalus superbus*), and from *Pseudechys porphyriacus*. In one copper-head no fewer than 129 specimens were to be counted in the lungs and trachea, of which 20 alone were males.

In the account of the external anatomy attention is drawn to the primary and secondary papillæ; the cuticle consists of a very thin external layer, which stains more deeply than the main portion; the former portion alone forms the ridges. The cuticle is secreted by columnar cells, between which spaces are left, through which there pass to the cuticle the ends of muscle-fibres and of special strands of connective tissue.

With regard to the muscles, Prof. Spencer emphasizes the fact that, so far as he has been able to observe, all the muscles of the body are distinctly striated. In the description of the mouth and pharynx an account is given of five main sets of muscles.

The most striking feature in the anatomy of *Pentastomum* appears to be the great development of glandular structures of an excretory nature. The author describes them under the heads of (1) hook-gland, (2) head-gland, and (3) parietal cells, while a body of uncertain nature lies above the very anterior end of the mid-gut. The author suggests that this rich supply of glands may be for the purpose of preventing the coagulation of the blood on which *P. teretiusculum* exclusively feeds.

A detailed list is given of the nine sets of nerve-branches given off from the subesophageal nerve-mass. On some of the papillæ there are sense-organs well supplied with nerves, and it is suggested that their function is tactile: they are probably sensitive to such stimuli, for example, as those produced by the flow of blood through vessels close to them; a stoppage in the flow, and hence in the food-supply of the parasite, would be detected. It is perhaps by these that the *Pentastomum* learns of the death of its host, when it wanders out from the lung in the characteristic way in which parasites leave the body of a dead host.

A full account is, finally, given of the somewhat complicated reproductive apparatus of both sexes. This valuable contribution, which is very well illustrated, does not, from its mass of facts, lend itself to an abstract.

Active Migration of *Pentastomum denticulatum*.†—Prof. S. von Rátz, from the observation of a number of cases, comes to the conclusion that it is probable that *Pentastoma* are able to wander actively from the organs of their first host by means of the respiratory organs, whence they reach the air-passage, and so the outer world. As suggested by Gerlach, those that migrate into the air-passages and nasal cavities may there become sexually mature; in this way there may be self-infection, and we may thus explain the rare cases of the presence of sexually mature *Pentastoma* in the nasal cavity and pharynx of herbivorous forms. The author supposes, however, that this active migration is a rare phenomenon.

* Quart. Journ. Micr. Sci., xxxiv. (1892) pp. 1-73 (9 pls.).

† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 329-33.

e. Crustacea.

Minute Structure of Gills of *Palæmonetes varians*.*—Mr. E. J. Allen points out that the main venous channels in the gill of this Crustacean have the cells which form their walls interrupted at various points; the intercellular spaces which are left are in direct communication with the blood-channels, and are filled with blood. The statement, therefore, that the circulatory system of Decapods is everywhere closed does not appear to be true. It was in the masses of cells surrounding the venous channels that Kowalevsky found the litmus deposited a few hours after injection, and it seems fairly certain that these cells exercise an excretory function.

In addition to these excretory cells a large number of glandular bodies occur in the axis of the gill. These glands, which are spherical in shape, are composed of large conical cells; some have the body staining deeply, others only faintly, and they may be distinguished as the reticulate and the clear glands. This appears to be the first time that glandular bodies have been observed in the gills of Crustacea, though Braun has observed similar structures in other parts of the body of various Decapoda, and P. Mayer and Claus have described glands in the Phronimidæ which may be looked upon as a stage of those in *Palæmonetes*.

Stridulating Apparatus of Red Ocypode Crab.†—Dr. A. Alcock suggests that the sound made by the red Ocypode Crab that swarms on all the sandy shores of India may be used as a warning note to others of its kind which are flying from enemies that the burrow to which they are retreating is already occupied. It is true that this crab is gregarious, but it does not appear to be social, and we must, therefore, look for an explanation of the phenomenon in something that is useful to the individual.

Deep-Sea Paguridæ.‡—MM. A. Milne-Edwards and E. L. Bouvier have a preliminary report on the Paguridæ collected during the expeditions of the 'Travailleur' and the 'Talisman,' as well as on those collected by some less notable expeditions. Of the forty-four species collected twenty-three are new, and of the twelve genera represented three are new. Attention is drawn to the extraordinary plasticity of the Paguridæ; while *Anapagurus* and *Catapagurus* and others have only one sexual tube (which itself varies greatly in form and position), *Nematopagurus* and *Catapaguroides* have two, the right of which is always much more developed than the left. A progressive disappearance of some of the appendages may be seen in *Sympagurus*; there may be remarkable variations in the number and development of these paired appendages; and proof is afforded of the weakness of the artificial barrier set between *Sympagurus* and *Parapagurus* and based on the form and number of the branchial elements.

Cancellus, a true Pagurid, has at first a close resemblance to the macrurous *Pylocheles*. A very valuable portion of the collection consists

* Quart. Journ. Micr. Sci., xxxiv. pp. 75-84 (1 pl.).

† 'Administration Report of Marine Survey of India for 1891-2.' See Ann. and Mag. Nat. Hist., x. (1892) pp. 336 and 7.

‡ Ann. Sci. Nat., xiii. (1892) pp. 184-226.

of species of *Glaucothrē* which are very poorly represented in museums, and it is now demonstrable that they are young stages in the lives of other genera of Pagurids.

In these deep-sea forms, as in many others, there is no apparent relation between their organic characters and their more or less abyssal habitat. Eyes are generally well developed, and sometimes are remarkable for the great extent of their corneal surface; in *Catapaguroides microps*, as the specific name denotes, the eyes are small, but the creature is not blind. *Parapagurus pilosimanus* is remarkable for its almost absolute indifference to the variations of the external medium and the great range of its depth. The authors are of opinion that the Pagurid fauna of deep waters is chiefly constituted by species which are more or less near the *Macrura*; these species gradually disappear as we approach the shores, where their place is taken by other species which are less close to the primitive forms.

The generic characters are given for the new genera *Nematopagurus* (*N. longicornis*) and *Catapaguroides* (*C. microps*, *C. megalops*, and *C. acutifrons*).

Occurrence of Cumacea in New Zealand.*—Mr. G. M. Thomson, by the discovery of *Cyclaspis levis* and *Diastylis neo-zealanica*, puts on record for the first time the occurrence of Cumacea in New Zealand waters. Only three have as yet been recorded from the Australian Seas.

Deep-water Crustacea of Green Lake.†—In an account of the fauna of this large American lake Mr. C. Dwight Marsh calls attention to the presence of *Pontoporeia Hoyi* and *Mysis relicta*. The existence of these deep-water forms in Scandinavian lakes is explained by supposing that the bodies of water in which they are found were formerly connected with the sea, but this does not seem to be the case with the American lake, and the problem therefore remains for the present insoluble.

Amphipoda and Isopoda of West Coast of Scotland.‡—Mr. D. Robertson has a second contribution towards a catalogue of these Crustaceans. To his former list of 175 species he is now able to add 60, many of which are new to Scotland, and some only recently described. Nearly all have been taken in the Firth of Clyde. *Socarnes erythrophthalmus* is a new species, and the new genus *Pararistias* is made for *Lysianassa Audouiniana*.

Breeding of Small Crustaceans.§—Dr. W. Koehs, recognizing the importance of small Crustaceans as a food-supply for fishes, e. g. carp, has made experiments on their artificial multiplication. Water in which they thrive best is too impure for most fishes; what is good for the Crustaceans is generally bad for the fish. But by a graduated series he has shown how cow-dung may be advantageously transformed into fish-flesh (“Umwandlungsprozess von Kuhdünger in Fischfleisch”). On the banks of the pond the breeding-places of the Crustaceans should be disposed with perforated boxes or flower-pots of cow-dung, and by various

* Journ. Linn. Soc. Lond., xxiv. (1892) pp. 263-71 (3 pls.).

† Trans. Wisconsin Acad., viii. (1892) pp. 211-13. }
 ‡ Trans. Nat. Hist. Soc. Glasgow, iii. (1892) pp. 199-223.

§ Biol. Centralbl., xii. (1892) pp. 599-606.

arrangements which need not be detailed here he seems to have succeeded in showing how the fishes may be provided with abundant food.

Oogenesis in Cyclops and Canthocamptus.*—Dr. V. Häcker finds in the oogenesis of *Canthocamptus staphylinus* that the longitudinal splitting of chromatin elements in the coil stage has nothing to do either with a primary or with a secondary longitudinal splitting of the elements of the directive spindle, but depends on a special process of doubling (diplosis) which is interpolated between the last division of the primitive ova and the definite appearance of a germinal vesicle. In the directive spindles two successive reductions occur, so that the number of chromosomata (doubled by diplosis) is quartered or reduced to half of that characteristic of the species. The divisions of the primitive ova are followed by a separation, splitting, and rearrangement of the chromosomata, the final result being a longitudinally cleft chromatin loop. There is no resting state represented by a chromatin reticulum. Certain changes initiating the stage of maturation give rise to a simple plate-like or lens-like mass; this is succeeded by a ring and a double plate, from which by subsequent splitting there arise four rods. Each rod is composed of six spherical segments, at the equator of which, at right angles to the longitudinal axis of the rods, the chromatin substance lies. Of the four rods, two pass into the first polar body, one into the second, and one remains in the female pronucleus. A longitudinal cleavage of the chromatin elements persists throughout.

In the same way in *Cyclops strenuus* and *C. signatus* the longitudinal cleavage of the chromatin threads follows the division of the primitive ova, and the double system persists throughout the entire growth-period of the egg. Before the beginning of the polar-body formation four double segments appear which are divided into eight double rods. Two remain in the egg. Both the divisions of the maturation period occur in the oviduct. The shortening of the oogenesis in these cases is, perhaps, an adaptation to the "semi-pelagic" character of the species; on the other hand, in perennially reproductive species, such as *C. brevicornis*, *C. tenuicornis*, *C. agilis*, and *C. pulchellus*, there is a typical resting stage of the nucleus during the growth-period, and a consequent prolongation of oogenesis. The frequent occurrence of a resting blastoderm stage in Cladocera is, perhaps, likewise adaptive. Dr. Häcker has been able to trace the return of the second polar body into one of the segmentation cells. In the stage with two segmentation cells each nucleus is still visibly composed of two distinct halves.

British Cladocera.†—Mr. D. J. Scourfield records as British *Ceriodaphnia megops* G. O. Sars, *C. quadrangula* O. F. M., *Daphnia hyalina* Leydig, *D. galeata* G. O. Sars, *Alona intermedia* G. O. Sars, and *Chydorus ovalis* Kurz. In some of these the female alone is known.

Vermes.

a. Annelida.

Sensory Epithelia of Annelid Worms.‡—M. E. Jourdan has investigated the sensory epithelia of *Rhynchobolus siphonostoma* Clap., *Syllis*

* Zool. Jahrb., v. (1892) pp. 211-48 (1 pl.).

† Journ. Quek. Micr. Club, v. (1892) pp. 63-9 (2 pls.).

‡ Ann. Sci. Nat., xiii. (1892) pp. 227-58 (2 pls.).

spongicola Gr., *Hesione sicula* D. Ch., *Arenicola grubii* Clap., and *Hermella alveolata* Lam. The author makes use of the term sensory nerve termination instead of any one more precise, because he believes that, in the present state of our knowledge, it is rash to speak too strictly. In the first place it is clear that the sensory nerves terminate in contact with an epithelium and not in the subjacent layers. The termination is generally to be found in the appendages with which the surface of the animal's body is provided, such as the tentacles, palps, cirri, or elytra, but it is sometimes on the body-wall at spots where there are no appendages. The nerve-fibres may come into relation with cells of the type of the olfactory rods of Vertebrates, in a number of cases the nerves enter into relation with ciliated cells, and in yet others it is impossible to distinguish the epithelial cells in which the sensory nerves end from the cylindrical covering elements. The author comes to the conclusion that it is not possible to characterize an organ as sensory by the nature alone of the epithelial cells which bound it; it is only by attentive study, by the examination of structure, and by the relations of the various elements which enter into its constitution that one can be certain if it belongs to the organs of the life of relation.

Study of Tubificidæ.*—Miss Harriet Randolph has been able to make an investigation into the structure of *Sænuris velutina*, which was first described by Grube, and has since been the object of some doubts. She confirms the accuracy of Grube's description, but as she found an allied species which also presents points of distinction from all other Tubificidæ, she purposes to place them both in the new genus *Embolocephalus*; the name is based on the power possessed by both species of withdrawing or invaginating the head. It is proposed to call the new species *E. plicatus*. The chief generic characters appear to be the presence of a covering in which foreign bodies are deposited, and of non-retractile sensory organs arranged in rings on each segment, as well as the retractility of the head and the absence of eyes. Specific distinctions are to be found in the arrangement of the sensory papillæ, and of the nephridia, in the presence or absence of a proboscis, and in the form, number, and arrangement of the setæ. The great interest of the genus lies in its exhibiting affinities to the Naidomorpha and points of distinction from other Tubificidæ, and the affinities to the one group or the other appear to be almost impartially shared by the two species. The genus is also interesting as an example of the strongly coloured inhabitants of deep water.

Aquatic Oligochætous Worms.†—Mr. F. E. Beddard commences with some notes on a species of *Dero*, the vascular system of which is remarkable from the fact that there are six pairs of contractile lateral vessels in segments vi.–xi. *Pristina longiseta* has been observed in England, and the author thinks that the observations of Prof. A. G. Bourne show that the two genera *Pristina* and *Naidium* can no longer be distinguished. There are some observations on the incompletely known *Acolosoma niveum*, which by its colourless integument and two kinds of setæ offers a transition to the Naidomorpha. It seems probable

* Vierteljahrschr. Naturf. Gesell. Zürich, xxxvii. (1892) pp. 145-7.

† Proc. Zool. Soc. Lond., 1892, pp. 349-61 (2 figs.).

that M. Vaillant should not have united but have left distinct the two genera *Clitellio* and *Limnodrilus*. A new genus named *Kerria* intermediate between *Acanthodrilus* and *Ocnodrilus* is next described. With the exception of a *Pachydriulus* no Oligochaete has before been found in exceedingly salt water, and it is therefore called *K. halophila*; it was found by Mr. J. Graham Kerr in the upper reaches of the Pilcomayo river. Mr. Beddard chiefly confines himself to the points of taxonomic importance, and shows that its affinities are as already stated. It must be placed in the large and imperfectly known group which he has called that of the Cryptodrilidæ.

New Genus of Enchytræidæ.*—Dr. H. Ude gives a short description of a new Enchytræid which he found at Altenar under moss on the stump of a tree, and which he proposes to call *Bryodrilus Ehlersi*. The setæ are of the *Pachydriulus*-type, and are arranged by fours or fives; there are four proportionately small enteric pouches, which are directed backwards. The dorsal vessel arises much further back than in any known allied Enchytræid.

Earthworms of the Berlin Museum.†—Dr. W. Michaelsen describes a number of new species of Earthworms from the Berlin Museum, but makes no generalizations. From Africa the new forms are *Benhamia inermis*, *B. pallida*, *B. gracilis*, *B. Büttneri*, *B. togoënsis*, *Kynotus Kelleri*, and *Eudrilus Büttneri*. *Perichæta heterochæta* Mich. from the Azores is recognized as a synonym of the widely spread *P. indica*. From America comes a new genus *Tykonus* (*T. grandis*) allied to *Anteus*; *Anteus papillifer*, *A. brunneus*, *A. Appuni*, *A. callichætus*, *Pontodrilus arenæ*, *Eudrilus roseus*, *Acanthodrilus platurus*, *Perichæta pallida* are new species. The only new form from Australia and Polynesia is *Perichæta neoguineensis*. From Asia there come *Moniligaster japonicus*, *Perichæta pulchra*, *P. Hilgendorfi*, *P. albida*, *P. longa*, *P. Ukedemi*, *P. mandhorensis*, *P. Martensi*, *P. divergens*, *Megascolex iris*, *M. margaritaceus*, and *M. pictus* spp. nn. *Pleionogaster* (*P. Jagori* and *P. samariensis*) is a new genus of Perichætidæ in which there are several postclitellial stomachs. *Perichæta monilicystis* is the only new species from Europe, but it was found in a hothouse in the Botanical Garden at Berlin, where it may have been introduced.

Trocheta subviridis.‡—Prof. R. Blanchard has made a careful inquiry into the geographical distribution of *Trocheta subviridis*, of which he gives a detailed account. He comes to the conclusion that it may be regarded as a form peculiar to Western Europe.

Notes on Hirudinea.§—Prof. R. Blanchard deals, in the third of his communications, with various species of *Nepheleis*; he treats in greatest detail *N. atomaria* Carena, but has notes also on *N. octocolata* Bergmann, and short descriptions of two new species which he calls *N. gallica* and *N. tergestina*.

Xerobdella Lecomtei.||—Dr. R. Blanchard gives a description of this terrestrial Leech, first described, in 1868, by von Frauenfeld; he has

* Zool. Anzeig., xv. (1892) pp. 344 and 5.

† Arch. f. Naturg., lviii. (1892) pp. 209-61 (1 pl.).

‡ Actes Soc. Ligust. Sci. Nat., iii. 4 (1892) 31 pp. (sep. copy) (8 figs.).

§ Bull. Soc. Zool. France, xvii. (1892) pp. 165-72 (5 figs.).

|| Mem. Soc. Zool. France, v. (1892) pp. 539-53 (9 figs.).

had the advantage of examining, among others, a living specimen, but he confines himself at present to an account of the external characters. He is not, therefore, at present able to explain the curious fact that there are two orifices on the female somite; attention is also called to an infundibuliform pore on the ninety-fifth ring which does not seem to have a homologue in any known Leech.

B. Nemathelminthes.

Gordius pustulosus.*—Prof. L. Camerano has found this rare species as an abundant parasite in *Blaps mucronata*. It has indeed been previously found in species of the same genus, but only on some three or four occasions. Camerano has also found it in *Sphodrus leucophthalmus* and *Harpalus aeneus*. In *Blaps* both males and females occurred. He believes that the early development, at least in the subterranean passages of Turin, occurs in damp earth, and that *Blaps* is in these cases the only host.

Helminthological Notes.†—Prof. M. Stossich has notes on a new series of Venetian Helminths collected by A. Conte Ninni. The series includes *Filaria Ninnii* Stossich, *Hystrichis tricolor* Dujardin, *Dispharagus spiralis* Molin, *Echinorhynchus lanceolatus* Linstow, and many others.

Anatomy and Life-history of Strongylus convolutus.‡—Dr. H. Stadelmann gives some details as to the anatomical structure of this parasite of cattle; the larvæ, when they escape with the fæces, seem, to judge from the presence of pharyngeal teeth, to be able to live a free life for some considerable period; but they may be known from *Rhabditis*-forms by having only one and not two bulbous swellings in the fore-gut. It has not yet been possible to trace the larva further.

Embryonic Development of Strongylus paradoxus.§—Herr B. Wandollech gives an account of his observations on the development of this Nematode. He was able to confirm the observations of Götte on *Rhabditis*, for he observed that when there were only two blastomeres, they lost their spherical form and became pear-shaped; then the one which contained no yolk-grains sent out a broad finger-shaped process over the other, which did the same on the opposite side. This is the first sign of the overgrowth of the endoderm by the ectoderm, for all the tissues which arise from the ectoderm are derived from the blastomere which is poor in yolk, and all the endodermal tissue from that which is rich in it. The first line of cleavage is not, as usually, meridional but equatorial; this seems to be true of all Nematodes. The elements of the ectoderm are finely granular, small and hyaline; the tail-cells, like the endodermal pieces, are large and filled with yellowish yolk. The mesoderm arises from two mesoblasts which are derived from the endoderm; these give rise to mesodermal stripes, and as they are formed a slit-like blastopore becomes apparent which soon closes up.

In the latter portion of his memoir the author gives a short account of the chief organs developed from each of the germinal layers.

* Atti R. Accad. Sci. Torino, xxvii. (1891-2) pp. 598-607 (1 pl.).

† Glasnik Hrv. Nar. Družtva (Soc. Hist. Nat. Croatica), vi. (1891) pp. 4 (1 pl.).

‡ Arch. f. Naturg., lviii. (1892) pp. 149-76 (1 pl.).

§ Tom. cit., pp. 123-48 (1 pl.).

Nervous System of *Ascaris megalocephala*.*—Herr R. Hesse contributes the following new points to our knowledge of the nervous system of this parasite. The sensory organs in the lips are of two kinds; there are papillæ, the nerves of which pass through an orifice of the cuticle by merely becoming thinner, and there are others in which only a filamentar prolongation of the nerve traverses the cuticle, under the orifice of which there is stretched a membrane, the centre of which is perforated by the nerve. The distribution of the sensory organs is symmetrical; the lateral nerves open at every pair of papillæ; the submedian nerves open at the labial sensory organs. The ventral nerve is doubly strengthened by the lateral ganglia; a lateroventral nerve-bundle enters on either side, parallel to the nerve-ring, into the subcuticle, and a second into the connective-tissue bridge of the excretory vessel; on its course as on its entry into the ventral cord there are numerous ganglionic cells. Of the commissures which pass from the ventral to the dorsal cord twice and a half as much goes by the right as by the left lateral; the arrangement of these commissures differs but little in the two sexes. The sublateral nerves traverse the whole body of the animal, and at the hinder part of the body they pass into the lateral lines; in the male the lower sublateral nerve in the tail end is strengthened on either side by the addition of nerves from the ventral line; they thus become bursal nerves, but there is no *nervus recurrens*. In the female there are, near the tail end, a number of commissures which extend from the ventral line to the lateral, but they are of small size. The vulva is only feebly innervated; behind it there lie, at various distances dorsally from the lateral lines, papillæ; these are found also in the male. The dorsal and ventral cords divide at the caudal end; the whole nerve-mass of each side is united into a lateral cord; these lateral terminal nerves finally pass into one another.

Embryos of *Filaria Sanguinis Hominis*.†—MM. de Nabias and Sabrazé's found in the hydrocele fluid of a patient who had just come from Guadeloupe, numerous mobile embryos of *Filaria sanguinis hominis*. They remained alive for two days, and their disappearance is supposed by the authors to be due to the development of bacteria in the fluid, for when 1 per cent. osmic acid was added the embryos lived for five days. The embryos possess neither alimentary canal nor generative organs, but consist of a number of nucleated cells; in this collection of cells a clear space can be observed and this is supposed by the authors to be the site of the future alimentary canal or of the sexual organs.

Classification and Distribution of Chætognatha.‡—Herr S. Strodthmann, after a general résumé of the structure of the Chætognatha, enumerates the points which are of value in classification. These are (1) the size of the sexually mature animal, the proportion of length to breadth and of the three segments to one another; (2) the number, position, and size of the fins; (3) the thickness of the epidermis and the size of the lateral enlargements of the same; (4) the number,

* Zeitschr. f. Wiss. Zool., xlv. (1892) pp. 548-68 (2 pls.).

† La Semaine Méd., 1892, p. 212. See Centralbl. f. Bakteriolog. u. Parasitenk., xii. (1892) p. 171.

‡ Arch. f. Nat., lviii. (1892) pp. 333-77 (1 pl.).

size, and form of the hooks and teeth; (5) the form of the olfactory organ; and (6) the development of the generative organs. Three genera are recognized, *Sagitta* with eleven species, *Krohnia* with two, and *Spadella* with seven; three species cannot be definitely assigned to a genus. Tables giving the distinctive characters of the species are appended, and there are, in conclusion, some observations on the distribution of the forms that are found in the North Atlantic.

The number of examples of Chætognatha is so great that it would be one of the most interesting of biological questions to determine the part that they play in the economy of marine life.

Helminthological Notes.*—Prof. M. Stossich has notes on numerous species of Trematoda, Cestoda, Nematoda, and Acanthocephala, chiefly in regard to their distribution in various hosts. He notes and figures some structural features of *Echinorhynchus teres* Westr., *Tænia serpentulus* Schrank, *T. Vallei* Stossich, *Ascaris ensicaudata* Rud., *A. scombrorum* Stossich, *Dispharagus aduncus* Creplin, *Heterakis monticelliana* Stossich.

Distomidæ of Mammals.†—Prof. M. Stossich gives a list of sixty-one species, with their various hosts, and a corresponding list of eighty-three mammals with the Distomidæ known to be parasitic in each. The whole matter is very clearly and tersely presented.

Trematodes of *Box salpa*.‡—Dr. F. S. Monticelli finds in *Box salpa* three Trematodes already known in this host and one new form. He gives a description of one of the known forms, *Monostomum capitellatum* Rud., and of the new species *M. stossichianum*, contrasting both in detail with *M. spinosissimum* Stossich.

Life-history of *Distoma hepaticum*.§—Dr. A. Lutz finds that the liver-fluke which has been seriously infesting cattle and horses in the Hawaiian Islands passes its asexual life in a *Lymnæus*, which he had been led to regard as *L. pereger*, but which Leuckart in a note identifies (on O. Böttcher's authority) as *L. cahuensis* Soul. Dr. Lutz notes that the Cercariæ are only liberated from their host when it dies or when the shell is broken. He relates his experiments in infecting guinea-pigs and other small rodents. In a species of *Melania* he found in great abundance other rediæ than those of the liver-fluke; of these he promises an account. The author gives many interesting details in regard to *Distoma hepaticum*, which, apart from his discovery of a new host, are of interest, e. g. the great mortality among the infected snails, which are literally "eaten up of worms," as many as 200 rediæ occurring in one animal.

Classification of Cestoda.||—M. A. Villot, in referring to the embryological researches of B. Grassi and G. Rovelli, maintains strongly the justice of his previous classification of cystic forms into Cysticerci, Cysticercoides, and Pseudocystici.

* Glasnik Hrv. Nar. Družtva (Soc. Hist. Nat. Croatica), vii. (1892) 10 pp. (2 pls.).

† 'I Distomi nei Mammiferi. Lavoro monografico,' 8vo, Trieste, 1892, pp. 42.

‡ Atti R. Accad. Sci. Torino, xxvii. (1891-2) pp. 514-3† (1 pl.).

§ Centralbl. f. Bakteriolog. u. Parasitenk., xi. (1892) pp. 783-96 (1 fig.).

|| Zool. Anzeig., xv. (1892) pp. 210-12.

γ. Platyhelminthes.

Sommer's Plasmatic Vessel in *Tænia*.* — Prof. F. Blochmann recalls the views, nearly all adverse, which have been published since, in 1878, Sommer described plasmatic vessels in *Tænia saginata* and *T. solium*. He is for both of these species able to completely support the accounts of Sommer and Nitsche, as he has been able to trace the course of the vessel with ease. So satisfied indeed is Prof. Blochmann with Sommer's account, that in place of giving a description of his own, he cites a long passage from that author in which he finds but few points to correct. It is suggested that the granular deposits which are often found in the organs of *Tænia saginata* and *T. solium* are generally due to drugs introduced into the intestine of the host; at any rate, these coloured deposits have only been seen in tapeworms that have been taken from the human subject.

δ. Incertæ Sedis.

Distribution of Rotifers.†—Dr. O. E. Imhof notes the following occurrence of marine and brackish water Rotifers, 9 in the Baltic, 25 in the North Sea, 1 in the Irish Sea, and 7 in the Mediterranean. The North Sea contains 23 species not as yet observed elsewhere. Of "eurhyaline" forms which occur both in fresh and salt water 40 species are recorded.

Revision of the Genus *Asplanchna* and its Hungarian Representatives.‡—In this paper Dr. E. von Daday tabulates and describes the known species of *Asplanchnæ*; he recognizes the following nine species:—

A. priodonta, *A. herrickii*, *A. syrinx*, *A. brightwellii*, *A. amphora*, *A. sieboldii*, *A. intermedia*, and *A. ebbesbornii*.

A. helvetica and *A. krameri* are declared to be synonymous with *A. priodonta* and probably rightly so.

But it is not quite clear why the author has admitted *A. syrinx*, which, according to Ehrenberg, has a foot, and which on this account has been placed in the genus *Asplanchnopus* by Hudson and Gosse.

A. girodi of de Guerne is more probably synonymous with *A. brightwellii* than with *A. syrinx*.

Dr. v. Daday, in describing the trophi of *Asplanchna*, states that the two thin blades (Reservekiefer) situated outside the stout rami, are mere appearances produced by folds of the membrane of the mastax, a statement which is hardly correct.

New Rotifers.§—Dr. D. Bergendal in a preliminary notice states that he has founded a new genus *Gastroschiza* for *G. triacantha*, a remarkable new species closely allied to *Euchlanis lynceus* of Ehrenberg, which he refers to his new genus. He states that in his complete work he gives reasons for showing that it must form the type of a new family of Rotifers, not obviously allied to any already known. Another new

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 373-9 (3 figs.).

† Biol. Centralbl., xii. (1892) pp. 560-66.

‡ Math. u. Naturw. Berichte aus Ungarn, ix. (1891) pp. 69-89 (2 pls.).

§ Lunds Univ. Årsskrift, xxviii. (1892) 2 pp. (sep. copy).

genus, which has no foot, but has a carapace, has certain points of resemblance to *Gastroschiza* and may be called *Anapus* (*A. ovalis* sp. n.).

Proales.*—Mr. P. G. Thompson has some notes of observations on the quasi-parasitic habits of members of this genus of Rotifers, and describes a new species, *P. daphnicola*, which he found in a pond at Leytonstone, Essex, roaming about on the body of *Daphnia pulex*; it appears to be allied to, though not identical with, Plate's *Furcularia Gammari*.

New Rotifer.†—Mr. J. C. Thompson describes, in the middle of Prof. Herdman's general report on the results of the cruise of the 'Argo' to Norway in 1891, where it is very likely to be overlooked, *Anuræa cruciformis* sp. n., taken in the Bukken Fjord. The lorica is so tessellated as to show a cruciform marking, and is divided into six nearly equal portions.

Macrotrachelous Callidinæ.‡—Mr. D. Bryce thinks there is no doubt that *Callidina constricta*, *C. tridens*, *C. musculosa* and *C. reclusa* must be added to the ten species allowed to belong to the genus *Callidina*. In all, indeed, he knows of twenty-one, four of which he describes in the present paper, and of those nineteen are British. The macrotrachelous forms are those in which, when fully extended, the post-anal portion is decidedly shorter than the pre-intestinal; most live on the stems, leaves, or bracts of various mosses. The author recommends the student to pay special attention to the trochal discs, the shape of the rami and the number of their teeth, and the spurs, which are very distinctive, among other points. The new species receive the names of *C. plicata*, *C. lata*, *C. spinosa*, and *C. aspera*; they were found in Epping Forest, Folkestone, and the Isle of Wight.

Echinodermata.

Cuvierian Organs of *Holothuria nigra*.§—Mr. E. A. Minchin corrects certain errors in Bell's descriptions of these organs, which appear to him to be due to the fact that spirit specimens only were examined. The organs do not, as has been stated, arise from the cloaca and they are not closely united into a firm bundle; if the organs are placed in spirit they adhere to one another and to everything they touch, so that in spirit specimens perfectly misleading appearances are obtained. In fresh specimens the organs are seen to be quite separate from one another and to arise independently from the left respiratory tree. A healthy animal always contains an enormous number of tubes and they take up a very large space in the body.

The most curious property of these organs is their power to elongate to a relatively enormous extent. When the threads are first ejected there is at the end of each a thicker portion or head, which is easily seen to be the cause of the movement. "One might compare the head to a rocket, and the thread to the trail of sparks emitted by it." As the head is generally slightly curved it runs in any direction, and, as a

* Science Gossip, 1892, pp. 219-21 (1 fig.).

† Trans. Liverp. Biol. Soc., vi. (1892) pp. 77-81.

‡ Journ. Quek. Micr. Club, v. (1892) pp. 15-23 (1 pl.).

§ Ann. and Mag. Nat. Hist., x. (1892) pp. 273-84 (1 pl.).

consequence, the irritating body becomes enveloped in a network of delicate but exceedingly tenacious and sticky threads. A healthy Holothurian can emit the tubes five or six times in succession; the only object to which they do not appear to adhere is the slimy body of the Holothurian itself.

Mr. Minchin is of opinion that each Cuvierian tube possesses a sort of automatic power of rapidly elongating, the explanation of which must be sought for in the structure of the organs themselves, and which, therefore, he is not at present able to give. At any rate in *H. nigra* the power of elongation is not due to the presence of fluid.

It would appear that the normal process of ejection is this; irritation of the skin of the Holothurian is ultimately transmitted to the base of the Cuvierian organs; certain of these commence to elongate with great rapidity, soon find their way out of the body, and continue to elongate outside; as they are generally directed by the animal some of the tubes are almost certain to come in contact with, and stick to the irritating body or foe. After this they break off at their point of attachment to the respiratory tree, and new organs begin to replace them.

The next question is, how do the tubes pass through the wall of the gut? From the observations and dissections which he has made Mr. Minchin thinks that the Cuvierian organs, after commencing to elongate within the body, are in some way directed to the wall of the cloaca, which they break through. It is possible that the powerful contraction of the body-walls, compressing the liquid in the cœlom, causes the wall of the body-cavity to break at its weakest point, which is, presumably, the dorsal wall of the cloaca through which the organs are then forced. The author has often found pieces of the cloacal wall ejected with the organs.

Mr. Minchin is inclined to agree with Hérouard in considering these organs as a modified portion of the respiratory tree. It is well known that Holothurians easily eject their viscera, and experiments in feeding show that these viscera are very unpalatable to a number of animals. As the expense of repairing these viscera must be considerable, Mr. Minchin suggests that the Cuvierian organs are simply a portion of the viscera specially modified for ejection.

Echinochrome.*—Dr. A. B. Griffiths has some observations on this respiratory pigment, which was discovered by Dr. MacMunn in 1883, in the perivisceral fluid of certain Echinoids. He finds that it has the empirical formula of $C_{102}H_{99}N_{12}FeS_2O_{12}$. On being boiled with mineral acids it is converted into hæmatoporphyrin, hæmatochromogen, and sulphuric acid. The first of these, which was found by MacMunn in the integument of *Asterias rubens* and other Echinoderms, is, very probably, derived from the pre-existing echinochrome. In some points echinochrome resembles hæmoglobin and chlorocruorin, and it is probable that it is a respiratory pigment in a lower state of development.

Organogeny of *Amphiura squamata*.†—M. L. Cuénot points out that Mr. MacBride in his recent paper ‡ on the development of *Amphiura*

* Comptes Rendus, cxv. (1892) pp. 419 and 20.

† Zool. Anzeig., xv. (1892) pp. 343 and 4.

‡ See ante, p. 621.

squamata gives some results which he has himself already published. With regard to the statements that there is no trace of an oral lacunar ring, and that the radial lacunæ are only apparent and due to the cells of the deep surface of the radial nerve-trunks M. Cuénot remarks that he has been able to find them. The difficulty of discovering them is due to the small size of the species examined, which has really the same organization as larger Ophiuroids.

Variations of *Pontaster tenuispinis*.*—Prof. F. Jeffrey Bell, who has had the opportunity of examining a large number of specimens of this species, points out that there are considerable variations in the proportion of the length of the arm to the radius of the disc, and that it grows to a fairly large size. The superomarginal plates also vary considerably in size, the papularia are sometimes quite indistinct, and there are considerable individual differences in the disposition of the spines on the actinal surface and along the ambulacral groove. He concludes that one variety and two species that have been lately separated all belong to one variable form.

Structure of Skeleton of *Culcita*.†—Dr. C. Hartlaub calls attention to the marked difference between the rows of brachial plates and the discoidal plates on the ventral surface of this curious Starfish, and points out their extremely regular arrangement. On the dorsal side he distinguishes a central and a peripheral region, and describes the peculiar stellate plates which are at first in contact, and are afterwards connected with one another by special trabeculæ. The region of the stellate plates does not, as in *Nidorellia*, directly touch the superomarginals, but is separated from it by a special row of large vertically disposed plates. Dr. Hartlaub offers critical notes on the already described species, of which he also gives a synoptical key, with a review of their distribution.

Cœlenterata.

Histology of *Ctenophora*.‡—Dr. P. Samassa undertook an inquiry into the histology of the Ctenophora with the special view of investigating the nervous system, the characters of which have been so differently described by various observers. The epithelium is seen at its simplest in *Euchlora*, where each cell is capable of producing the characteristic granules; in *Hormiphora* most parts of the body have a simple epithelium, but in the stomach and the glandular stripes there is a differentiation, as some of the cells are secretory and others interstitial. The highest stage of this differentiation is seen in *Beroe* and *Cestus*, where the connective-tissue character of the interstitial tissue is marked by its fibrous structure. The author believes that most of the various forms of cells which are seen in the Ctenophora are referable to various stages of gland-cells. The resemblance between the epithelium of Ctenophora and that of Turbellaria, especially Polyclads, is very striking.

With regard to the otoliths all authors agree that they are formed by epithelial cells and expelled from them; but in *Beroe* it is easy to

* Proc. Zool. Soc. Lond., 1892, pp. 430-3 (1 pl.).

† Notes Leyden Museum, xiv. (1892) pp. 65-118 (2 photo plates and 4 figs.).

‡ Arch. f. Mikr. Anat., xl. (1892) pp. 157-243 (5 pls.).

convince oneself that a nucleus is attached to each otolith; in *Hormiphora* and *Callianira* the otoliths are much more firmly attached to one another, but between them there are thin protoplasmic walls, to which the nuclei are often attached. The otoliths, therefore, are not, as has been hitherto supposed, cell-products but epithelial cells themselves which have become set free from the epithelium. There is a unilaminar ciliated epithelium in the polar plates, and there is no difference between the plates; the author, therefore, is unable to confirm the statement of v. Lendenfeld that there are special spindle-shaped sensory cells in the polar plates of *Neis*.

The structure of the tentacles is dealt with in some detail, and it is concluded that the facts point pretty clearly to the mesodermal origin of the axis of the tentacle; the so-called seizing cells appear to be composed of at least two cells, the glandular portion of which is fundamentally the same as the glandular cells of the epithelium; neither in *Callianira* nor in *Hormiphora* does the tentacular apparatus contain any cells which can be regarded as nervous.

The author's examination of the tissues leads him to the conclusion that the Ctenophora have no nervous system, although he believes them to be in a condition which must have preceded the formation of the nervous system in bilateral animals. Kleinenberg and the Hertwigs, in their speculations on the origin of the nervous system, have postulated a primary connection between it and the musculature; but one system is ectodermal, the other mesodermal in origin; the connection between the two is, therefore, secondary.

If, without any regard to phylogenetic speculations, we examine the facts of development we find that an ectodermal nervous system and a mesodermal musculature exist for a time independently of one another. Though a musculature without a nervous system is possible, a nervous system without a musculature is unthinkable, for it would have no function. If, therefore, it existed it must have had some other function. This condition appears to be represented in the Ctenophora; they possess a mesodermal musculature which functions without the intermediation of a nervous system. The sensory bodies and the median bands are regarded as the predecessors of the nervous system, and in the Ctenophora there are various stages of development which lie on the direct road to a conversion into a nervous system.

The Lobatæ and the Cestidæ exhibit the primitive condition, the ctenophoral plates being connected by ciliated bands; the whole meridian band consists of a continuous row of ciliated cells, which appear to be specially modified only in the ctenophoral plates. In *Callianira* and *Hormiphora* there are no ciliated bands between the basal cushions; these are connected by fibres which may, physiologically, have a nerve-like function; but these fibres possess no nuclei, they are merely continuations of cells of the cushion. The next stage is seen in *Beroë*; here the epithelial cells of the basal cushion are separated from the rest of the epithelium, and are connected with fibres which connect the cushions with one another. Physiologically they clearly have a nerve-like function, and as they have also the histological characters of nerve-fibres, there is no reason why they should not be called so. But, in *Beroë*, the musculature is also considerably altered; while in *Hormi-*

phora and *Callianira* it has no special relation to the meridian bands, there is in *Beroë* just under the basal cushions a layer of longitudinal and a layer of transverse fibres, which cause the contractility of the ctenophoral plates.

With regard to the difficult question of the systematic position of the Ctenophora the author urges that even if they can be shown not to be derived from polyp-like forms the similarity of the gastrovascular system offers a great difficulty to separating them from the Cnidaria, and he concludes with urging various considerations in favour of the hypothesis that the Turbellaria are derived from the Ctenophora.

Segmentation of Ovum of *Æquorea Forskalea*.*—Dr. V. Häcker finds the ovum of this large Craspedote a suitable object for the study of the early stages of the egg of the Medusæ. The first stages are gone through with the greatest regularity; the nuclear divisions as far, at least, as the 64-stage are, under normal circumstances, quite simultaneous, and the blastomeres appear to be normally all of the same size. Where there are irregularities there are pathological forms of nuclear divisions, and the cell-complex loses its spherical form. Before the directive corpuscles begin to be formed the ovarian nucleus takes on a vesicular form; the sperm-nucleus always has a radiate form. With regard to the law as to the number of chromosomes the author thinks it is clear that all known cases may be arranged in one of these systems, and that closely allied forms are generally seen to belong to one and the same system.

Growth of *Clavularia ochracea*.†—Herr G. v. Koch observed that the longitudinal growth of a stolon of this coral continued during a period of twenty days at an almost constant rate of slightly over .5 mm. per diem. On an average a new polype was formed every six days.

Heteromorphosis of Hydroids.‡—Herr Hs. Driesch describes the diverse modes of growth in two forms of *Sertularella*, which, though nearly related (if indeed different) species, behave quite differently in relation to external influences. As the one is affected by light, so is the other by the force of gravity. His results, and those of Loeb, with a discussion of which the present communication is in great part occupied, "are all against the interpretation of development as a specialization of an essential substance (idioplasm). A segmentation-cell may according to its position take part in one or another organ of a Sea-urchin, and a polyp may give rise to another polyp or to a stolon, and a stolon to another stolon or a shoot, according to the influencing conditions."

Hydrocorallinæ of Torres Straits.§—Dr. S. J. Hickson has a notice of a small collection of Hydrocorallines, represented by *Millepora Murrayi*, *Distichopora violacea*, and *Stylaster gracilis*, made by Prof. A. C. Haddon in Torres Straits in 1888-9. The author thinks it probable that in some cases the male, female, and immature colonies of one and the same species have been made separate species, and

* Arch. f. Mikr. Anat., xl. (1892) pp. 243-63 (2 pls.).

† Morphol. Jahrb., xviii. (1892) pp. 605-8 (1 fig.).

‡ Biol. Centralbl., xii. (1892) pp. 545-56 (3 figs.).

§ Scient. Proc. Roy. Dublin Soc., vii. (1892) pp. 496-510 (3 pls.).

that the tendency of those who, in the future, examine the structure of both the hard and soft parts together will be rather to diminish than increase the number of existing species.

Some of the specimens in the present collection have been so carefully preserved as to bear, with excellent results, the most elaborate histological treatment. The structure of the soft parts of *Stylaster gracilis* agree very closely with that of *S. densicaulis*, as described by the late Prof. Moseley, but there are usually twelve tentacles on the gastrozooids, instead of eight. Nematocysts appear to be confined to the tips of the dactylozooids. The muscular slip of the dactylozooid consists of a thin sheath of ectoderm covering a bundle of parallel muscular fibres, which are doubtless of ectodermic origin; if so, the endoderm is entirely obliterated in this "slip." The ripe eggs are 0.25 mm. in diameter, and are, therefore, considerably smaller than the eggs of *Distichopora* or *Allopora*; the early stages of the developing egg resemble those already described by the author for the two just-mentioned genera. It is thought possible that *Stylaster* has been derived from a form closely resembling *Allopora* by the terminal branches remaining more delicate, and consequently, showing more definitely than the ancestral type the regular alternate method of gemmation.

The marked differences in colour presented by different specimens of *Distichopora violacea* are due to differences in age and sexual condition. Some details are given as to the histology of the two kinds of zooids of this species, and it is remarked that the mesogloea is much more extensive than in *Millepora*; the skeleton is not in close contact with the ectodermal cells in the deep parts of the corallum, but lies imbedded in the mesogloea. In *Millepora*, on the other hand, the mesogloea is represented by a very thin perfectly structureless lamella, which is situated between the ectoderm and endoderm, and the skeleton lies in all cases outside the ectoderm, in close contact with its cells.

In conclusion it is pointed out that some problems must remain unsolved till well-preserved specimens of *Millepora* have been re-examined.

Formation of Germinal Layers in Hydromedusæ.*—Herr W. Gerd reports that he has observed in *Bougainvillea* an equal division into two and four blastomeres, and a cœloblastula, the fate of which was, however, different from that described by Metschnikoff. In this form the cells divide in tangential directions, and increase in numbers while the nuclei take up a peripheral position, they elongate in the radial direction, and so diminish the cavity of the cœloblastula. In the course of further cell-multiplication the boundaries of the cells become indistinct. Later on, there is a migration of cells into the interior of the cœloblastula; there is a multipolar migration which leads to the formation of a compact morula in which the peripheral and central nuclei are altogether identical. As in the case of *Tubularia*, described by Brauer, the result of migration is not a planula, but a morula.

* Zool. Anzeig., xv. (1892) pp 312-6.

The processes observed in *Bougainvillea* and *Tubularia* cannot be adapted to the schemes of Hydromedusan development which have been sketched by Metschnikoff and Tichomirow. In both these forms there is a process of migration, as well as delamination. The modes of germinal layer formation seen in *Bougainvillea* and *Tubularia* are distinguished from those described by Metschnikoff for the Craspedota in that the result of migration is not a planula with sharply limited layers, but a compact stage with completely identical cells. This stage may be called that of the pseudomorula.

This formation of a pseudomorula by means of migration instead of a planula, may be partly explained by supposing that the cœlo-blastulæ do not represent free living forms, as in the Craspedota. A stage of specialization in which the migrating cells can be easily distinguished from those of the blastoderm has not yet been reached.

The specialization of the ectoderm-cells and the formation of the structureless lamella is here not an act of germinal-layer-formation, but the further development of the peripheral layer of the pseudomorula.

Budding in Hydra and some Hydroid Polyps.*—Herr A. Lang has examined the mode of budding in *Eudendrium ramosum*, *E. racemosum*, *Plumularia echinulata*, and *Hydra grisea*. He finds in all four that the bud does not, as has been hitherto believed, form an evagination of the common body-wall at a definite point, but that it is formed by the ectoderm only of the parent. What happens is this; the ectoderm thickens in a zone of gemmation which is definitely fixed for each species; it is due to a steady division of the cells of the ectoderm; in *Hydra* and *Eudendrium* the division occurs in the so-called indifferent or interstitial cells; and the division is ordinarily transverse, and is always indirect. The growth of the ectoderm goes on for some time without any changes in the endoderm of the area of gemmation. When the thickening is of some size, the cells that lie next the supporting lamella break free and begin to wander through it. The cells which lie on the endodermal side of the supporting lamella and their successors form the endoderm of the bud. Between them and the still growing ectoderm the supporting lamella is formed anew. In *Hydra* and *E. ramosum* there may be seen, in sections, numerous cells whose protoplasmic processes clearly point to their power of independent amœboid movement.

The endoderm of the cœnosarc at the point of budding is pushed out by the young bud-endoderm, and is gradually absorbed partly by it and partly by the neighbouring endodermal cells of the cœnosarc tube. The young bud-cells quickly grow to the size of typical endodermal cells. It may easily be seen in *Hydra* that it is only definite cells of the thickened ectoderm that are converted into endodermal cells, while others become stinging or epithelio-muscular cells.

The gastric cavity of the primitively solid bilaminar bud arises from a cleft which is formed internally to the altered ectodermal cells.

If we compare the gemmation of Hydroid Polyps with their embryonic development we find striking points of resemblance. If we compare the ectoderm of the area of gemmation to the blastoderm, the

* Zeitschr. f. Wiss. Zool., xlv. (1892) pp. 365-85 (1 pl.).

ectodermal thickening may be regarded as the introduction to the formation of endoderm. The latter is, of course, so far modified that the immigrating cells must press through the supporting lamella, and the old endoderm must be removed. In addition, the ectoderm of the bud is no longer histologically indifferent, like the blastoderm, and it is not every cell of it which is still sufficiently indifferent to become an ectodermal cell. In other points the form of endoderm is the same in embryonic development and in budding. The form is known to arise by hypotropic (one-sided) or multipolar (all-sided) immigration of blastoderm cells.

If the facts here related should be shown to have a general significance, the process of gemmation in all Cnidaria, and perhaps in all Coelenterata, would be referable to the blastula-stage, or, be regarded as derivable from the incomplete division of the blastula. Hitherto, gemmation has been regarded as the incomplete division of a completely developed form, in consequence of the incorrect view that, from the first, both layers took part in forming the bud.

Metschnikoff has given an account of an incomplete and multiple division of the blastula in *Oceania armata*, and it may be supposed that this happens in other forms also. The division of the blastula may, again, be regarded as the asexual reproduction of a hypothetical blastula-like stem-form of the Coelenterata, which has been atavistically retained in the blastula-stage of the latter.

At first buds could be formed at any point of the body of the Hydroid, but it was necessary to limit them to definite spots or zones in the interest of the formation of regular colonies.

The mode of budding in Annelids and the strobilation of Scyphopolyps and of Cestoda is one in which all the germinal layers of the parent take part, and it is quite fair, therefore, to suppose that this mode of budding is derived from the capacity for regeneration.

Porifera.

Excretion in Sponges.*—Mr. G. Bidder, who has recently suggested that the granular cells, which he has called "Metschnikoff cells," and the glandular ectoderm cells have an excretory function, now gives an account of observations which he thinks prove this idea to be correct, as far as, at any rate, *Ascetta* is concerned. After leaving a sponge in a solution of indigo-carmin in sea-water he found that the granules which are normally present in the Metschnikoff and ectoderm cells become replaced by dark-blue granules. The Metschnikoff cells of *A. clathrus* are almost always excavated by a cavity or duct which frequently takes the form of a capillary and sometimes branching tube; they push through towards the ectodermal surface, with which they become connected, and the granular film covering the general gastral surface disappears. Later on the cells are perforated nearly from end to end, and, when they discharge their granules from the external as well as from the gastral surface the lumen is completed, and a perforation through the wall is formed which, on the regeneration of the gastral epithelium, persists as an afferent pore.

* Proc. Roy. Soc. Lond., li. (1892) pp. 474-84 (4 figs.).

Mr. Bidder suggests that, primitively, the afferent pores of Sponges are perforated excretory cells derived from the endoderm, while the ectoderm is a layer of cells excreting constantly from the intercellular jelly, their glass-shaped form having been developed to expose the greatest possible surface to the medium from which the excreted substance is derived. They have been differentiated on the exterior as a covering to the nutritive and reproductive cells of the Sponge, in order, by reason of their noxious contents, to form some protection to the naked protoplasm.

It is suggested, as a proper subject for expert chemical analysis, the investigation of the extent of the alliance of the substance excreted by Calcareia in the granules of the Metschnikoff and ectoderm cells with the so-called spongin. The last term, as used by zoologists, is applied to a number of different nitrogenous substances found as supporting structure in a large group of more or less allied Sponges. The author suggests, as a working hypothesis, that the yellow granules of *Ascetta clathrus* are a soluble nitrogenous excretion which is highly mutable, and readily gives rise to the less soluble substances which occur with it in the granules of other Homocœla. The horny sponges are, it is suggested, those that have learned to retain within their bodies this nitrogenous secretion of the protoplasm, common to all Sponges, till it has formed one or other of those more or less insoluble products which are grouped together under the term Spongin.

Recent Researches on Sponges.*—Dr. O. Maas emphasizes the diploblastic nature of the sponge-embryo; the layers might be spoken of as ectomesoderm and endoderm. From his own studies on the development of *Esperia*, Topsent's observations on Clionidæ, and Minchin's account of *Leucosolenia clathrus*, the author regards the contractile elements as originally ectodermic. A primitive state with ectodermic contractile cells persists in *Leucosolenia*, but it is not justifiable on that account to include all contractile cells as ectodermic (as Topsent does), for in the more highly differentiated forms the contractile elements form part of the middle stratum, as F. E. Schulze has described in horny sponges. There is as much reason for calling the spicule-forming cells and the amœboid wandering cells ectoderm.

Histology of Calcareous Sponges.†—Dr. R. v. Lendenfeld calls attention to some points in Mr. E. A. Minchin's paper on *Leucosolenia*,‡ in which he thinks an incorrect account has been given of his views, or structures regarded in an erroneous manner.

Protozoa.

Merotomy of Ciliated Infusorians.§—Prof. E. G. Balbiani gives an account of some fresh experiments on the division of Ciliated Infusorians. The more or less large fragments which are separated from the body of a *Stentor* generally close quite easily the wound produced by the section; the edges of the wound come together almost at once, owing to the elasticity of the cuticle, and the contractility of the muscular

* Biol. Centralbl., xii. (1892) pp. 566-72.

† Zool. Anzeig., xv. (1892) pp. 277-9.

‡ See this Journal, ante, p. 491.

§ Ann. de Microgr., iv. (1892) pp. 369-407, 449-89 (3 pls.).

fibres. The local modifications of the wound, and the contractions of the body which aid in closing it should be considered as phenomena caused by the wound. The phenomena of excitation may be observed as well in the fragments or merozoites which contain a nucleus as in those that have none. After this period of excitation, which is generally of short duration, the fragments regain the regularity of their movements, and their normal orientation—behave, in a word, like ordinary Stentors. The most obvious and most remarkable phenomenon of merotomy is the rapid and complete regeneration of the merozoites which contain the whole or part of a nucleus. If the peristome be removed it is reformed by a rudiment which, as in reproduction by division, appears at first on that part of the ventral surface which was called by Schuberg the branching zone. The new peristome is then completed by a mouth and an adoral zone, which are also formed as in the process of division. The contractile vesicle is reproduced, not as a new organic formation of the protoplasm, but by a simple local dilatation of the previously existing excretory system. The reconstitution of the nucleus is the last act in the regeneration of the merozoite; it is effected by successive divisions of the nuclear joint or joints which the merozoite first contained. The nuclein increases in quantity at the expense of the protoplasm. The regeneration of the merozoite is sometimes followed by a tendency to multiplication by division, but the new parts are soon reabsorbed, and the individual regains its primitive appearance. This phenomenon is probably due to increased physiological activity of the nucleus caused by the lesion.

The merozoites which do not contain any part of the nucleus are never converted into a complete individual; if this portion contains the mouth or anus it ingests food or gets rid of undigested masses, just like normal individuals. This shows that the nucleus has no influence on the ingestion or removal of food. Merozoites without a nucleus do not survive for more than forty-eight hours at the most; the cause of death is the alteration of the protoplasm, which becomes vacuolated or spongy in consequence of an inhibition of water and, perhaps, also from the arrest of the functions of assimilation.

The opinion of Gruber that the nucleus is necessary to give an impulse to the new organs and useless for their further development is inexact; the presence of a new nucleus is indispensable for all the stages in the formation of the organs. The "micronucleus," whether alone or accompanied by the nucleus, takes no part in regeneration or the other vital manifestations of the protoplasm. Its office is to intervene in the phenomena of conjugation; it is, to use the expression of Bütschli, a sexual nucleus. The non-intervention of the micro-nucleus in the vital phenomena of protoplasm is again shown by the fact that it has no influence on the intracellular absorption of the joints of the old nucleus, at the time of conjugation. It is only when it has by its fusion with a congeneric element of another individual become a true active nucleus that it has an effect on the absorption of the old nucleus. This absorption, which has a close resemblance to the digestion and assimilation of food, is probably effected by a secretion which has its seat in the protoplasm, and is, like other secretions of the Protozoa, dependent on the nucleus.

Fragments removed by artificial division from a Stentor in the state of conjugation are regenerated when the joints of the nucleus which these fragments contain still present a clear and homogeneous appearance, which is a sign of their vitality. In the more advanced stages, when these joints are greyish and granular—a sign of their approaching disintegration—the fragments are not regenerated. After a certain time the pieces which contained them degenerate and die. At the same time these fragments regain the power of regeneration when a new nucleus makes its appearance in the protoplasm. The author thinks that the experiments he relates show clearly the physiological influence of conjugation.

Nutrition of Trichosphærium.*—Herr F. C. Noll observes that in his aquarium *Trichosphærium Sieboldii* Schn. feeds on diatoms, clearing small areas on the surface of the glass. On such places the Rhizopod multiplies rapidly.

Structure of Peridinidæ.†—Dr. F. Schütt distinguishes a cortical plasma (*Hüllplasma*) from an internal plasma (*Füllplasma*). The former includes a hyaline layer and a granular layer. Within the granular layer are various kinds of bodies, notably minute plate-like chromatophores, fat-plates, small rods, bundles of threads, and plastids which are probably fat-formers. The internal plasma includes no granular bodies, but a nucleus, sap-chambers, and a vacuole-apparatus. The latter includes a large sac-vacuole with an efferent duct, a smaller collecting-vacuole also opening near the flagellum-cleft, minute daughter-vacuoles which surround the collecting-vacuole, and fourthly, but exceptionally, diffuse accessory vacuoles. No pulsations were observed, but it is likely that the daughter-vacuoles empty their contents into the collecting vacuoles. “Collecting- and sac-vacuoles are morphologically equivalent organs,” without homologues in the cells of higher plants; the sap-chambers are quite distinct from the vacuoles and correspond to the sap-cavities in plant-cells.

Argentine Gregarinida.‡—Prof. J. Frenzel describes five new species, *Gregarina statiræ*, *G. bergi*, *G. panchloræ*, *G. blaberæ*, and *Pyxinia crystalligera*, but the interest of his communication is chiefly physiological. By microchemical analysis he distinguishes the following substances:—(1) Protoëlastin, the substance of the cuticle and perhaps of the epimerite membrane, of the partition, and of the nuclear wall; insoluble in acetic and nitric acids, alcohol, ether, chloroform, &c.; soluble more or less in alkalis; altered into a non-elastic substance by acetic acid; for the most part insoluble in saliva, but digestible. (2) Alveolin, the substance of the mesh-work; insoluble in acetic, sulphuric, and nitric acids, caustic potash and saliva; fixed by alcohol, corrosive sublimate, &c.; stained by carmine; not exhibiting iodine reaction. (3) Paralveolin, accompanying alveolin, but soluble in saliva, acids, and alkalis. (4) Neutral fat, in drops, especially in the protomerite. (5) Albuminoids, some fixed by corrosive sublimate, others also by acids. (6) Protocollagen, swelling in acetic acid and

* Zool. Anzeig., xv. (1892) pp. 209–10.

† SB. K. Preuss. Akad. d. Wiss., 1892, pp. 377–83 (1 pl.).

‡ Jenaische Zeitschr. f. Naturwiss., xxvii. (1892) pp. 233–336 (1 pl.).

partially in nitric acid, shrivelling up in water. (7) Paraglycogen, in the granules; iodine reaction red-violet with help of sulphuric acid, or acetic and nitric acids; changed by warm sulphuric acid into sugar (Bütschli) or also by saliva and sulphuric acid. (8) Pyxinin, the corresponding substance in *Pyxinia*, changed by acetic or nitric acid into an amorphous substance without iodine reaction. (9) Anti-enzym, a hypothetical substance which hinders digestion. (10) Morulin, the substance of the nuclear-morulite; soluble in nitric acid, not in acetic, nor thoroughly in enzymes. (11) Paramorulin, the network in the nucleus, fixed by acetic and nitric acids, digestible, = Linin? (12) Nuclein, in the nucleoli of *Pyxinia*, &c. (13) Nuclear-sap. (14) Cell-sap. And besides these, account must be taken of the granules which occur in regular rows, those of the anterior protomerite, of the deutomerite, and of the epimerite, and finally the sarcocyte-fibrils and the rare vacuolar spaces. Frenzel has also endeavoured to prove the likelihood of the occurrence of a diastatic ferment. He compares the Gregarine to an absorbing intestinal cell, and believes the above analysis to be of interest in considering the processes of digestion and absorption in Metazoa.

New Sporozoa.*—Dr. P. Mingazzini describes *Gonobia colubri* g. et sp. n., which occurred mixed with the spermatozoa in the vas deferens and testes of *Zamenis viridiflavus*. In the oviduct and ova of the female the coccidian appears to complete its life-cycle. The author gives other examples of Sporozoa associated with ova, e. g. in *Lacerta*. In the pyloric appendages of *Sphyræna vulgaris* another new form, *Cretya neapolitana* g. et sp. n., was found by Dr. C. Crety; it exhibits an exceedingly distinct plasmic reticulum.

Pulmonary Gregarinosis in Stillborn Child.†—Sig. A. Severi relates the case of a stillborn child in whom the lungs were extremely large and atelectatic. Sections showed that the pulmonary tissue was beset with cell-elements, partly singly, partly arranged in nests, and these the author took to be Gregarinæ (Monocystidea) from their morphological and tinctorial characters.

Coccidium Infection.‡—Of the Coccidia hitherto recognized, says Dr. L. Pfeiffer, some inhabit epithelial cells, some the blood. The best known example of the former is *Coccidium oviforme* Leuckart, the ovoid cysts of which are found in the intestine and liver of rabbits and of man. In the salamander dwells *Karyophagus Salamandræ* Steinhaus which is identical with *C. proprium* s. *sphæricum* described by Schneider. In the intestinal epithelium of the Myriopod *Lithobius fortificatus* is found *Eimeria Schneideri*. The micro-organisms infesting the intestinal canals are very pathogenic to their hosts, ninety per cent. of rabbits attacked perishing from diarrhoea and spasms. Blood infection by Coccidia has not been often detected, although Bordier and Smith have found some forms in cattle, and Texas fever appears to be due to

* Atti (Rend.) R. Accad. Lincei (1892) pp. 396-402 (4 figs.).

† La Riforma Med., 1892, No. 80. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 262.

‡ Fortschr. d. Med., 1890, pp. 939-51. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 109-10.

Coccidia. Danilewsky has demonstrated their presence in lizards and birds. Of the pathogenic influence of these parasites little is known beyond that the spleen of the affected animals becomes enlarged.

The blood parasites bear much resemblance to the plasmodia of malaria although the plasmodium form is absent. According to the author tropical fevers owe their origin to other micro-organisms than the malaria plasmodia found in Europe.

Miescher's Tubes containing Micro-, Myxo-, and Sarcosporidia.*—Dr. L. Pfeiffer describes some infectious diseases which he has observed in the muscle-fibrils of the European mud turtle, in the muscles of barbel, and also in the pleura and peritoneum of sheep. The cornalia- or pébrine-corpuscles are identical with the exciting cause of the pébrine of silkworms and other insects. In the turtle the Microsporidia tubes are confined to the muscular system, while in insects they appear in all parts of the body, though in each species of silkworm a definite organ may be attacked by preference.

The Myxomycetes found by Müller, Telohan, Lutz, and others in different organs of fishes were first found by the author in 1890, in the muscles of diseased barbel from the Moselle-Saar-Rhine district. The barbel showed discoloured swellings of the skin and deep crateriform ulcers on the head, trunk, and tail, in which, together with cell-detritus and bacilli, psorosperms were found in quantity. The primary seat of the latter is within the muscle-cells. The other organs were found free in barbels but in tench the gall-bladder, swimming-bladder, spleen, and arteries were diseased. Whether this form of micro-organism possesses a resting phase is left in doubt.

Miescher's tubes are found in sheep, in goats and horses, and another species in pigs. Blanchard has also described them in the kangaroo. The disease is chronic and not unfrequently the micro-organisms become calcified. Feeding experiments made on rabbits, pigs, sheep, and dogs were devoid of result.

Cancer Parasites.†—Prof. P. Foà describes and depicts parasites which he has found in four out of seventy examinations of carcinoma of the mamma. The parasites have the appearance of coccidia and though not exactly alike possess certain general resemblances. They are spheroidal bodies, for the most part intracellular, but are also free between the cells, as is well shown in one of the illustrations. In number they seem to vary considerably, though most cells contain only one body. The general characters of these parasites are that they are spheroidal vesicular bodies with distinct investing membrane and central granular contents. The character of the contents varies: it may be gathered in the centre, having the appearance of an ordinary nucleus, or striations may proceed from this central mass towards the periphery; the whole of the "body" may be filled with small granules having the tendency to central aggregation. The contents in some instances are represented as being yellow, but whether this colour is intrinsic or

* Virchow's Archiv, cxxii. pp. 552-73 (1 pl.). See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 110-1.

† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 185-91 (2 colord. pls.).

due to staining is not quite clear. The tissues were hardened in sublimate and alcohol and stained with hæmatoxylin.

Pfeiffer's Parasitic and Pathogenic Protozoa.*—The second and much enlarged edition of Dr. L. Pfeiffer's work on the Parasitic Protozoa is on similar lines to its predecessor. The illustrations and the letterpress leave much to be desired, the former being extremely archaic and the latter full of typographical blunders. Yet this is the only work which deals with the very interesting problems connected with the symbiosis of Protozoa and the cells of higher animals. Many of these Protozoa pass the whole of their existence within cells, and the nature of their parasitism therefore becomes extremely interesting. Does their presence necessarily imply a pathogenic influence eventually destructive of the host? Are they merely harmless guests? Or is their parasitism potentially noxious, that is, requiring some further deciding factor than their mere presence for the development of disease.

In what way are they pathogenic? What is the nature of their pathology? Is it by their direct action on the infected tissues, the latter becoming so altered as to render them not only unfit for, but even noxious to the organism of their host, or is it from the absorption of the products of the metabolism of the parasites. All these questions and many others connected with the Protozoa remain to be answered, for very little is known about them, although during the past few years more attention has been devoted to the subject and the presence of parasitic Protozoa has been demonstrated for certain acute and chronic disorders in Mammals, Birds, and Reptiles.

But the author of the 'Parasitic Protozoa' is not content with a few sure and certain instances, he more than suspects that diseases such as herpes zoster, variola, vaccinia ovina, varicella, and perchance also scarlet fever, measles, molluscum contagiosum, and last but not least carcinoma are caused by intracellular parasitic Protozoa.

KRUSE, W.—Der gegenwärtige Stand unserer Kenntnisse von den parasitären Protozoen. (The present condition of our knowledge of Parasitic Protozoa.)

Hyg. Rundschau, 1892, pp. 357-80, 453-85.

* 'Die Protozoen als Krankheitserreger sowie der Zellen- und Zellkern-Parasitismus derselben bei nicht bakteriellen Infektionskrankheiten des Menschen,' 2nd edition, Jena, 1891. See *Centralbl. f. Bakteriolog. u. Parasitenk.* xii. (1892) pp. 168-71.



BOTANY.

A. GENERAL, including the Anatomy and Physiology
of the Phanerogamia.

a. Anatomy.

(1) Cell-structure and Protoplasm.

Pectic Substances in Plants.*—M. L. Mangin has studied the substances which come under this head, and which are found in a great variety of plants. They may be classed under two series, neutral and acid, though the substances pass from one to another by insensible gradations, varying in every degree from complete insolubility, through a condition in which they absorb water and swell, to complete solubility. The series of neutral substances comprises pectose, which is insoluble, and is intimately associated with cellulose in non-lignified and non-suberized cell-walls, and pectin, which is soluble, and more or less easily gelatinizable. The acid series comprises pectic acid, which is insoluble, and usually combined with the bases of the alkaline earths, and metapectic acid, which is completely soluble without gelatinizing. The chemical and staining properties of these substances are given in detail. Those of pectose are but little known, because those reagents which separate it from the cellulose with which it is intimately associated transform it into pectin. There is a close analogy between pectic substances and gums; the latter are formed by the disorganization of the former as well as of cellulose, and it is in this way that the mucilaginous substance which fills up the intercellular spaces is formed.

(2) Other Cell-contents (including Secretions).

Proteids of the Oat.†—Mr. T. B. Osborne gives further details respecting the proteids of the oat, which, he states, undergo great change by direct treatment with hot sodium chloride solution. It is probable that alcohol temporarily suspends a fermentation which is induced by water or solutions of neutral salts. The probable composition is given of the three primary proteids originally contained in the oat-kernel; one is soluble in alcohol, one, a proteid or globulin, is soluble in sodium chloride, and one is soluble in alkali.

Vegetable Cholesterins.‡—According to M. Gérard the cholesterins of the higher and those of the lower plants differ from one another in their chemical and physical properties. Those of Phanerogams have all the characteristics of Hesse's phytosterin; while those of Cryptogams give the reactions of Tauret's ergosterin. The former were obtained from the lupin, *Trigonella fœnum-græcum*, the seeds of *Datura*, and olive-oil; the latter from *Penicillium glaucum* and *Æthaliium septicum*.

* Journ. de Bot. (Morot), vi. (1892) pp. 206-12, 235-44. Cf. this Journal, ante, p. 223.

† Amer. Chem. Journ., xiv. (1892) pp. 212-24. Cf. this Journal, ante, p. 58.

‡ Comptes Rendus, cxiv. (1892) pp. 1544-6.

Vegetable Trypsin in the Fruit of Cucumis.*—According to Prof. J. R. Green the fruit of *Cucumis utilissimus* contains in its juice and in its pericarp a proteo-hydrolytic ferment capable of dissolving coagulated egg-albumen. This ferment is either a globulin in nature, or is associated with a globulin in the cells of the plant. Like papain, it works best in a slightly alkaline medium, less readily in a neutral one, and least of all in the presence of acid. Like papain, it effects a very complete decomposition of the albumen, giving rise to peptone, and later to leucin. It is, therefore, a ferment allied to the trypsin, or rather to the pepsin, of the animal organism.

New Gums from Leguminosæ.†—Mr. J. H. Maiden describes a gum of the nature of a kino which exudes from the “native Wistaria” of New South Wales (*Milletia megasperma*). It is a beautiful ruby-coloured transparent substance, and consists almost entirely of a tannin and water. Also another from the “barrister” (*Mezoneurum Scortechinii*), a horny gelatinous gum swelling up, but only slightly soluble, in cold water, soluble in dilute hydrochloric acid, and possessing properties very similar to those of tragacanth.

Action of Anilin on the Green Leaves of Plants.‡—Dr. E. Schunck and Mr. G. Brebner refer again to the action of anilin on many green leaves, manifested by the disappearance of the usual green, and the development of an intense brown colour, due to the formation of a peculiar well-defined crystallizable substance, anilinophyll. The formation of this substance is not, however, necessarily connected with the presence of chlorophyll, but is due to a process of oxidation which the anilin undergoes under certain conditions. The composition of anilinophyll is given as $C_{24}H_{10}N_3O$; its properties are described in detail. The rapidity with which it is formed varies greatly with different leaves; some do not turn brown at all under the action of anilin; while it is formed equally in etiolated leaves. In the opinion of the authors the phenomenon here described proves the existence in the cells of many plants, especially of the leaves, of some form of active oxygen in immediate proximity to, or associated with, the protoplasm during the living state of the cell.

Mineral Constituents of Etiolated Leaves.§—From experiments, chiefly on wheat, *Pisum sativum*, and tobacco, Prof. W. Palladin finds that the proportion of ash is much less in etiolated than in green leaves, and this he attributes to the diminished transpiration. The hypocotyl, on the contrary, of etiolated contains a larger quantity of ash than that of green leaves. Etiolated leaves are especially deficient in lime. When the transpiration is repressed, the amount of starch in leaves is enormously increased.

(3) Structure of Tissues.

Composition of Vegetable Tissues.||—According to M. G. Bertrand, lignified vegetable tissues consist essentially of four ingredients, cellu-

* Ann. of Bot., vi. (1892) pp. 195-202.

† Proc. Linn. Soc. New South Wales, vi. (1892) pp. 679-81.

‡ Ann. of Bot., vi. (1892) pp. 167-84.

§ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 179-83.

|| Comptes Rendus, cxiv. (1892) pp. 1492-4.

lose, xylane, vasculose, and lignin, the mode of separating which is given in detail. The experiments were made chiefly on oat-straw; but similar results were obtained from other parts of various plants—stems, leaves, fruits, &c.

Conducting Tissues of Plants.*—Prof. E. Strasburger gives in this work a very full account of the structure, and of the adaptations to their purpose, of the tissues through which the currents of water pass in the living plant.

Commencing with the Gymnosperms, he states that many of the Abietinæ have medullary rays of complex structure, the wood-rays containing water-conducting tracheids as well as living parenchymatous cells, while most Conifers have bordered pits on the tangential surfaces of the latest formed autumn wood; and the development of these two structures varies inversely. Both structures serve the purpose of providing a radial connection between the water-conducting tissues of successive annual rings. In both Gymnosperms and Dicotyledons there are always intercellular spaces containing air between the elements of the rays, and the living cells of the rays communicate by pits with these spaces.

As regards the companion cells, their functions are fulfilled in the Abietinæ by certain rows of cells belonging to the medullary rays of the phloem. In the other tribes of Coniferæ the structure varies. The sieve-plates are never open so long as the sieve-tubes are functional. The callus is stated to be formed directly from the protoplasm, as it is also in *Cucurbita*. The arrangement of the sclerenchymatous elements of the bast in most Conifers is such as to preclude the possibility of a mechanical function. The vegetative structure of Gnctaceæ more closely resembles that of Dicotyledons than that of Conifers.

Passing on to Dicotyledons, the function of the living protoplasmic layer lining the walls of the sieve-tubes (in *Cucurbita*) appears to consist in preventing diffusion from the tube, and in providing material for the formation of callus in order to close the plates when necessary.

In Monocotyledons the thickening-ring differs from the true cambium of Dicotyledons or Gymnosperms in the fact that there is no single initial row of cells, to the divisions of which all the secondary tissues can be traced. The secondary tracheids are really such, and not true vessels.

In Vascular Cryptogams, the author supports Van Tieghem's view that the prevailing structure of the stem in Ferns is polystelic; while the central cylinder of *Lycopodium* is regarded as gamostelic.

In his summary of anatomical results, the author points out that the protoxylem of each new shoot is continuous, not with the protoxylem of the next older shoot, but with its later-formed xylem. In this way only can a continuous water-channel be maintained. He adopts the view that the water-current passes through the cavities of the tracheæ; and he describes a number of experiments carried out on different lines which appear to him to prove conclusively that the rise of water in the tissues of plants is a purely physical process, not

* 'Ueber d. Bau u. d. Verrichtungen d. Leitungsbahnen in d. Pflanzen,' Jena, 1891; 1000 pp., 5 pls., and 17 figs. See Ann. of Bot., vi. (1892) p. 217.

dependent on the vital properties of the protoplasm; capillarity is of itself insufficient to explain the phenomenon, and transpiration is important only in so far as it makes room for the ascending water. The conditions necessary for the ascent of water are (1) that the cell-walls should be in a state of imbibition; (2) that the cavities of the tracheæ should be to a certain extent filled with water; and (3) that they should be isolated so as to exclude the entrance of air. Atmospheric pressure helps to keep the water suspended, but does not cause its ascent; and root-pressure is not immediately concerned in the process.

Appearance of the first Vessels in the Flowers in *Lactuca*.*—According to M. A. Trécul, in *Lactuca oleifera* and *L. perennis* the first vascular cells make their appearance only in the lobes of the corolla; while in *L. sativa* they appear both in the corolla-lobes and in the filaments; and in *L. virosa* in the filaments only. The first vessels of the stigmatic branches appear, in *L. sativa*, *oleifera*, and *virosa*, after those of the corolla and of the filaments; and in *L. perennis*, sometimes later than the first vessel of the ovary. Subsequently these vessels of the stigmatic branches, reinforced by numerous vascular cells, give rise to a bundle which descends into the style. The author further traces the order of appearance of the first vessels in the ovary and in the pedicel, which presents certain differences in the different species.

Comparative Structure of Woods.† — Herr Pommerenke notes several peculiarities in the wood of various trees belonging to symmetrical families from Argentina. He finds conjugating cells to be common in the medullary rays and the xylem-parenchyme, not only of the Ebenaceæ, but of other natural orders. Conjugation appears to depend on the occurrence of medullary rays consisting of only a single row of cells. These are frequently pinched in and compressed between elements which are often libriform fibres, but sometimes vessels or cells of the xylem-parenchyme. Between the medullary cells which are thus separated, delicate connecting tubes can be detected. A conjugation may also take place between dissimilar elements. Branched libriform fibres and tracheids were observed in several cases. The occurrence of patches of pith in the xylem was also noted.

Causes of Variation in the Density of Wood.‡ — According to M. E. Mer the density of wood depends on two factors, on the relation between the size of the cells and the thickness of their walls, and on the constitution of the walls and the extent to which they are lignified or impregnated by tannin and resin. The density, therefore, varies not only with the conditions in which the tree grows, but also in different parts of the same tree. In the inner or spring portion of a zone the cells are usually larger and have thinner walls than in the outer or summer portion of the same annual zone. When the activity of the cambium is greatest, cells of large size are formed rapidly, but the plastic materials are not present in sufficient quantity for the walls to acquire any great thickness, while the reverse is the case when the

* Comptes Rendus, cxv. (1892) pp. 8 i-92.

† JB. Schles. Gesell. Vaterl. Cultur, lxi. (1892) pp. 85-6.

‡ Bull. Soc. Bot. France, xxxix. (1892) pp. 95-105. Cf. this Journal, ante, p. 511.

activity of the cambium is diminished. The former is generally the case in the spring, the latter in the summer. The lowest branches of a tree and the lowest parts of a branch are those in which the activity of the cambium continues the longest; and these are therefore the regions in which the annual layers are the most developed. Broad layers with large thin-walled cells may, however, acquire great density from the walls becoming strongly impregnated with tannin or resin.

Influence of Annular Decortication on Trees.*—M. E. Mer has studied the effect produced on a variety of trees by the removal of a ring of bark; the result varies greatly according to a variety of circumstances. As a general law it may be stated, that when the decortication is performed in May, the branches formed subsequently in the region above the decortication are less vigorous, the foliage is paler, and a number of the buds remain dormant. In the region below the ring, on the other hand, no such deteriorating effect is at first produced; but, on the contrary, the leaves are larger and of a deeper green, and the growth of the branches is more rapid; the nitrogenous materials obtained from the soil become concentrated, owing to their not being able to pass the decorticated ring. But when the supply of starch in these parts is once exhausted, it is not again renewed. From this it follows that it is through the bark that the downward flow of food-material takes place, and the decortication puts a stop to this descent. The formation of cambium is, therefore, arrested, even in the region below the decortication; and the development of fresh rootlets also ceases.

Formation of Thyllæ in the Tracheids of Conifers.†—Herr W. Raatz has investigated the mode of formation of thyllæ in the wood of conifers, especially *Pinus excelsa*. They are frequently septated, and sometimes branch to such an extent that the original position of the cell can no longer be made out. When fully formed they have simple pits on all sides, including those which impinge on the walls of the tracheids. Similar thyllæ were found also in *Abies pectinata*, *Pinus sylvestris*, *P. Strobis*, *Picea excelsa*, *Larix europæa*, and *Thuja occidentalis*. They are much more numerous in the root than in the stem. The function of the thyllæ is evidently connected with the healing of wounds; they close up injured vessels (tracheids) in the same way as does an exudation of resin or gum. They are formed at the same time as the new parenchyme which closes the wound. It is very rarely that they are found independent of an injury. In the winter they contain abundance of starch, and serve as a reservoir for food-material.

Cystoliths.‡—According to M. L. Mangin, the matrix of cystoliths consists, in addition to cellulose, of pectic substances, and very frequently also of callose. The presence of the latter substance was shown by treating thin sections with a mixture of extra 6 B soluble blue and vesuvian brown or orcellin B B, which gives a characteristic blue colour with callose. Callose was detected in this way in the membranes or calcareous incrustations in a number of Urticaceæ, and in the hairs on

* Bull. Soc. Bot. France, xxxix. (1892) pp. 107-20.

† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 183-92 (1 pl.).

‡ Comptes Rendus, cxv. (1892) pp. 260-2.

the fruit of several Borragineæ. In the cystolith it occupies the whole of the original organic framework, and exhibits, after the removal of the lime, a fine stratification, and the characteristic ornaments or sculpturing. In the hairs and epidermal cells it occurs in different forms, and often in regions where there is no calcium carbonate.

Comparative Anatomy of Parasites.*—In the two volumes published of this work M. A. Chatin treats of the following orders of parasitical flowering plants:—Balanophoreæ, Cassythaceæ, Cuscutæ, Cytineæ, Epirhizanthæ, Loranthaceæ, Monotropeæ, Orobanchæ, Rafflesiaceæ, Rhinanthæ, and Thesieæ, including 70 genera.

In the Cassythaceæ the epiderm possesses numerous stomates, except on the absorbing organs. Tracheids are absent from the stem, but occur in the flowers and in the embryo. The vessels lose their tubular form, and become short and elliptical in their passage from the stem to the absorbing organs. Air-cells occur in the xylem-system, with the exception of the parenchyme. The stomates are placed at right angles to the epidermal cells. Phloëm is wanting; there are no medullary rays. Among the Monotropeæ *Hypopitys multiflora* presents several peculiarities, especially in the absence of absorbing warts, except in one instance.

Corky Excrecences on the Stem of "Zanthoxylum."†—Mr. C. A. Barber describes the nature and development of the corky excrecences on the stem of several species of "*Zanthoxylum*," and appends a list of plants whose thorns have a basal cork-formation. The structure of the corky cushion at the base of the thorn differs in its details in different plants. It is probable that, in the majority of cases, the function of the cushion is the retention of the thorn, at any rate in the young plant, after secondary thickening has commenced. In *Rosa*, however, its purpose appears to be the prevention of a rupture of the tissues on the forcible separation of the thorns. In *Cactus* the tough cushion at the base of each bunch of spines serves to glue together the spines and prevent their becoming detached.

Histology of Lauraceæ.‡—An essential oil is found in all species of this order examined by M. E. Perrot; it is contained either in special cells or in vesicles scattered through the parenchyme; and the bark always contains a great number of large mucilage-cells. The greater number of the oil-glands are usually located in the bast. In some genera, as *Cinnamomum* and *Laurus*, the mucilage-cells are mostly seated in the bast; in *Sassafras* in the pith. All the various kinds of cell may in some cases be detected in the embryo.

Structure of Aquilarieæ.§—M. P. Van Tieghem records the occurrence, in the Aquilarieæ, a tribe of the Thymelaceæ, of phloëm-islands in the secondary xylem. By this character the structure of the wood of the Aquilarieæ is sharply distinguished from that of the Thymelææ, the other tribe of its order.

* 'Anat. Comp. des végétaux; plantes parasites,' Paris, 1892, xv. and 560 pp. and 113 pls. See Bot. Centralbl., li. (1892) p. 211.

† Ann. of Bot., vi. (1892) pp. 155-66 (1 pl.).

‡ 'Contrib. à l'étude histol. d. Lauracées,' Paris, 1891, 62 pp. See Bot. Centralbl., 1892, Beih., p. 274.

§ Journ. de Bot. (Morot), vi. (1892) pp. 217-9.

Stem of *Wistaria*.*—Mr. C. C. Curtiss describes a peculiarity observable in old stems of *Wistaria sinensis*. After growth has continued normally for a series of years, usually twelve or more, a new cambium zone is formed outside the primary bast, and the old cambium dies. The growth of this secondary cambium continues for perhaps eight years, and then it dies and the same process is repeated. This method of development continues through life, stems twenty-five years old showing four or more bast-zones. All the elements of the wood, the xylem, phloëm, and periblem, receive their proportional annual increase with wonderful regularity, and the bast is of extraordinary strength. The structure of the various elements of the stem is described with great minuteness.

(4) Structure of Organs.

Metamorphosis and Idiomorphosis.†—Prof. F. Delpino regards the leaf, not as an independent organ, but as a section of a merithallus, the free projecting portion of a cone of growth, the remaining elements of which are closely united with one another to form the axial shoot. Of the various transformations of the leaf, the foliage-leaves, cotyledons, anther-lobes, and carpels are prototypic and primordial, as contrasted with the sepals, petals, tendrils, pitchers, &c. Of the cotyledons and foliage-leaves, the latter is probably the primeval form. The metamorphosis may be of many different degrees; of a low degree are scales, spines, tendrils, &c.; of a higher degree such organs as the perianth of *Aquilegia*. The homologous organs of different plants are not always of the same degree of metamorphosis; thus, the calyx of Malvaceæ is an involucre, that of *Helleborus* a true calyx, that of Rosaceæ a modification of the foliage-leaf, that of *Tradescantia* a modification of the corolla, &c.

The author applies the term *idiomorphosis* to certain special kinds of metamorphosis; such as that by which the petals of *Camellia* result from a modification of the bundles of stamens, as is shown in partially double flowers. Of the same nature are the petaloid sepals of *Polygala*, the petaloid bracts of *Salvia*, the petaloid involucre of *Astrantia*, the petaloid andrœceum of *Atragene* and *Nymphæa*, &c.

Vegetable Statics.‡—From experiments made on different plants M. A. Letellier is led to assert that segments of a root or stem, while still in a meristematic condition, float in a liquid of suitable density in a direction which is the same as that manifested during life. Hence he concludes that the orientation of the young parts of a plant is that which corresponds to a position of stable equilibrium. Descending roots have their centre of gravity below their centre of measurement; while in stems and ascending roots the relative position of the two centres is the reverse; rhizomes and secondary roots have their two centres so near to one another that their equilibrium is nearly indifferent. From mathematical reasoning, the author derives the two following laws:—
(1) The plant grows in the direction which favours its position of stable

* Journ. New York Micr. Soc., viii. (1892) pp. 79–89 (3 pls.).

† Mem. R. Accad. Ist. Sci. Bologna, ii. (1892) pp. 101–17. See Bot. Centralbl., li. (1892) p. 274.

‡ Comptes Rendus, cxv. (1892) pp. 69–72.

equilibrium; (2) when it departs from its position of equilibrium, it returns to it by curving at the point where it bends most easily.

Coalescence of Organs.*—According to Herr W. Figdor, a true concrescence of parts originally distinct is always effected by the formation of new cells. There are four degrees of union to be distinguished, viz.:—(1) A permanent concrescence (tuber of *Cyclamen europæum*, turnip); (2) Concrescence with subsequent formation of periderm (potato); (3) A union depending partly on concrescence, partly on the transformation of the injured cells into a cementing mucilage (beet, carrot, dahlia, artichoke); (4) In some cases underground tuberous organs, once separated, cannot again enter into organic union (*Iris germanica*, *Begonia*, *Stachys affine*). In order that true concrescence may take place, a definite minimum of transpiration must not be exceeded; there must be a sufficient space between the cut surfaces for the development of the new cells; and a certain pressure which apparently acts as an irritant must be applied to the parts that are to unite.

Fruit and Seeds of Compositæ.†—Herr R. Loose has compared the structure of the pericarp and seed-coat of 228 species of Compositæ. An aerial tissue is usually present, either uniformly distributed on all sides, or in special wings or cushions. The pericarp or testa generally contains mechanical elements, except in the case of very small seeds which are entirely enclosed in the involucre. Contrivances for fixing the fruit in the soil are rarely wanting.

Fruit and Seeds of Cyperacæ.‡—Herr E. Wilczek describes in detail the structure of the seed, integuments, and fruit of this natural order, taking as his type-species *Carex paradoxa*.

In the utricle the following distinct tissues can be distinguished:—the inner and outer epiderm, the swelling tissue, the aeriferous tissue, the vascular or mestome-bundle, and the bast or stereome-bundle. In the pericarp three layers may be distinguished,—the outer epiderm, the middle or stereid-layer, and the inner epiderm. The epiderm of the pericarp differs from that of grasses in having its outer wall not thickened, its inner wall strongly thickened, and in the presence of sclereids. The seed has in contrast to that of grasses a distinct funicle. It has an endosperm, but no perisperm. With regard to the mode of germination, the Cyperacæ belong to the palm-type, in which the absorbing organ, usually small and conical in the dormant seed, enlarges greatly on germination, and penetrates deeply into the endosperm.

The structure of *Carex paludosa* and of species belonging to some other genera is compared with that of *C. paradoxa*; and the species of *Carex* are grouped under two types, viz.:—(1) Utricle stout, fundamental tissue differentiated into aeriferous and aquiferous (*C. paradoxa*, *paniculata*, *teretiusecula*, &c.); (2) Utricle thin; fundamental tissue not differentiated (*C. paludosa*, *stricta*, *ampullacea*, *depauperata*, &c.) The strength of the pericarp is in inverse proportion to that of the utricle.

* SB. K. K. Akad. Wiss. Wien, c. (1891) pp. 177–200 (2 pls.). Cf. this Journal, ante, p. 68.

† 'Die Bedeutung d. Frucht- u. Samen-schale d. Compositen,' Berlin, 1891, 60 pp. and 2 pls. See Bot. Centralbl., 1892, Beih., p. 263.

‡ Bot. Centralbl., li. (1892) pp. 129–38, 193–201, 225–33, 257–65 (6 pls.).

Seed-coats of Euphorbia.*—Mr. L. H. Pammel describes the structure of the seed-coats in those species of *Euphorbia* which are natives of the United States. He finds that, from a systematic point of view, they offer but few characters of sufficient importance to use in distinguishing species. Where the outer surface of the seed shows sculpturing or marking, the minute structure indicates corresponding differences; the ashy part which covers many seeds is changed into mucilage on the addition of water, and in the case of *E. polygonifolia*, spirals are developed. Microchemically this mucilaginous substance appears to be similar to the mucilage of *Linum*, *Ruellia*, *Ocimum*, *Salvia*, &c. Underlying the mucilaginous layer is a narrow zone in which starch-grains are abundant.

Epiderm of the Seeds of Cuphea.†—Herr C. Correns describes the mechanism which causes the sudden appearance of a felt of hairs on the epiderm of the seeds of various species of Lythraceæ—*Lythrum thesioides*, *Peplis*, *Ammansia verticillata*, and especially *Cuphea viscosissima*—when wetted. From the inner side of the outer wall of each epidermal cell springs a coiled hair of nearly uniform thickness, which almost completely fills up the cell-cavity. The inner lamella of the cell-wall and the membrane of the hair give the reactions of cork. When moistened the outer wall of the epidermal cell still remains attached to one side like an open lid. The hair gradually uncoils, still clothed with a membrane, which is the inner lamella of the cell-wall. The remains of the protoplasm of the cell are at the same time expelled. The unfolding of the hair is not due to vital activity, since it takes place in preparations that have lain for some days in alcohol. It is a purely physical phenomenon, a process of swelling.

Tendrils of Passiflora.‡—Mr. D. T. McDougal describes in detail the morphology and anatomy of the tendrils of *Passiflora cærulea*, which consist of three distinct parts,—the base or non-coiling portion, the middle region or coiling portion, comprising the greater part of the organ, which is generally slightly curved, and the sharply curved or hooked tip. Near the extremity of the concave side of the tip is the oval aperture of the cup-formation. The whole organ shows a bilateral structure. All the tissues of the tendril are abundantly supplied with pits. The author believes that the concentration of the protoplasm in the epidermal layer has a direct connection with the irritability of the tendril, and that its movements are due to changes in the chlorophyll layer, the disposition of the xylem elements being favourable to rapid flexion and extension; the abundant supply of reserve food-material seems to be a provision for the rapid growth and fixation of the tendril upon coiling.

Comparative Anatomy of Cotyledons.§—Herr H. Klotz has examined the structure of the cotyledons in a number of plants belonging

* Trans. Acad. Sci. St. Louis, v. (1892) pp. 543-68 (2 pls.). Cf. this Journal, ante, p. 504.

† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 143-52 (1 pl.).

‡ Bot. Gazette, xvii. (1892) pp. 205-12 (1 pl.).

§ 'Ein Beitrag z. vergleich. Anat. d. Keimblätter,' Halle, 1892, 67 pp. See Bot. Centralbl., 1892, Beih., p. 260.

to different natural orders. Even in the young condition cotyledons exhibit three well-differentiated kinds of tissue—a rudimentary epiderm, a rudimentary parenchyme, and procambial bundles. The epiderm always consists of closely fitting cells of a smaller radial diameter than those of the parenchyme. The parenchyme is usually composed of several layers of isodiametrical cells. The procambial bundles consist of narrow elongated thin-walled cells fitting closely together. With the exception of the underground cotyledons of non-albuminous seeds, such as those of *Pisum* and *Æsculus*, most cotyledons have the power of growth; and this growth depends chiefly on the increase in size of the individual cells and their separation from one another, rather than on cell-division.

As contrasted with foliage-leaves, cotyledons have usually a larger number of layers in the mesophyll; their mechanical elements and the conducting system are less developed; the epiderm is less sharply differentiated; the number of cotyledons is usually smaller in proportion to the area, and they are more uniformly distributed on the two sides.

Leaves of Iridææ.*—Prof. R. Chodat and Mdme. G. Balicka-Iwanowska have studied the structure of the leaf in a number of genera of Iridææ. The leaf of *Roumulea*, although resembling that of *Crocus* in appearance, is, in reality, of the equitant type characteristic of most genera of the order. The epiderm is always composed of only a single layer of cells, the external wall of which is often furnished with cutinized pearls. The stomates have always four guard-cells, and the form of the cells is very uniform throughout the group, with a few exceptions. The hypodermal vascular bundles constitute a very characteristic tissue consisting of elongated prosenchymatous cells with thick walls and oblique striæ. The Ixiææ are distinguished from all the other genera by having a true mid-rib. It is rare to find in the order any true palisade-tissue.

Cells bordering the Guard-cells of Stomates.†—Herr W. Benecke describes the structure of the epidermal cells which he distinguishes as “Nebenzellen,” i. e. those cells bordering the guard-cells which differ considerably in form from the others belonging to the epiderm. The leaves examined were mostly more or less of a succulent character; and, after a minute description of the stomatal arrangement in a number of different natural orders, the author classifies the examples investigated as follows:—A, Stomates without border-cells (*Sedum penthorum*, *Subularia aquatica*, many Orchideæ); B, Stomates with border-cells; I. Type of succulents contracting on loss of water; α , the contraction takes place in all directions; α , 3 border-cells surround the guard-cells in all directions (Crassulaceæ, Plumbagineæ except *Armeria*, Urticaceæ, Begoniaceæ, Gesneraceæ, *Stapelia*, Cruciferæ, Violaceæ); β , 2 border-cells; either the stomate is parallel to the ideal axis of division (Portulacaceæ, *Mesembryanthemum*, Chenopodiaceæ, Asclepiadæ except *Stapelia*, Cactaceæ, Euphorbiaceæ), or at right-angles to it (Labiata, Acanthaceæ, Caryophyllaceæ, &c.); γ , 4 border-cells; either forming a

* Journ. de Bot. (Morot), vi. (1892) pp. 220-32, 253-67 (1 pl. and 13 figs.). Cf. this Journal, ante, p. 385.

† Bot. Ztg., l. (1892) pp. 521-9, 537-46, 553-62, 569-78, 585-93, 601-7.

regular rectangle (*Tradescantia*, *Commelyna*, *Pothos*, *Calandrinia*), or less regular (*Arum*, *Richardia*, *Vanilla*, &c.); *b*, the contraction affects the guard-cells chiefly from the sides, 2 border-cells (*Armeria*, *Claytonia*, many Monocotyledons); II. Coriaceous-succulent type; *a*, 2 or 3 border-cells surround the stomate (*Asclepiadeæ*, *Rhizophoraceæ*, &c.); *b*, 2 border-cells on one side of the stomate (*Maranta*, *Juncaceæ*, *Gramineæ*, *Cyperaceæ*). Many forms are of an intermediate character; thus *Mesembryanthemum* and the *Juncaceæ* and *Glumifloræ* might almost as well be placed under B I *b*.

Capitate Hairs and Motile Filaments of Dipsacus.*—Prof. R. Chodat and M. R. Zollikofer have investigated the nature of the trichomes found in the cup formed by the union of the bases of the opposite leaves of *Dipsacus sylvestris* and other species of the order, which they state to be totally different from those of *Lathræa*. They have been considered variously as threads of protoplasm, rods of wax, and bacteria. The authors have determined that they present none of the reactions of protoplasm; and they believe them to be simply excretory products endowed with remarkable powers of vibratory motion closely resembling those of animals. The interior of the cup is furnished with a large number of multicellular capitate hairs. At the summit of each of these hairs is one of the bodies in question, which may assume the form either of a button—usually sessile, less often stalked—of a hollow vesicle, or of several longer or shorter threads of great tenuity which display this remarkable power of motion, and possess the faculty of retraction.

Fastigiate Hairs of Potentilla.†—Dr. A. Waisbecker describes the fastigiate hairs which characterize the group *Aurææ* or *Stelligeræ* of *Potentilla* (*P. cinerea*, *aurea*, *opaca*, *arenaria*, *rubens*, *tirolensis*, &c.). Each consists of an epidermal cell which divides first by a septum parallel to the surface, and the lower segment, then by vertical septa into 2 or 3 cells which constitute the pedicel; the upper cell then divides further into a number of long radiating branches, frequently as many as from 10 to 20. These are often combined with another form known as “comb-hairs.”

β. Physiology.

(1) Reproduction and Embryology.

Staining-reactions of the Constituents of the Nucleus and of the Sexual Cells of Plants.‡—From a series of observations made chiefly on *Scilla sibirica*, *Hyacinthus orientalis*, and *Fritillaria imperialis*, Herr F. Rosen arrives at the following general conclusions. In the vegetative nucleus two kinds of nucleoles may be distinguished,—the erythrophilous or *eu-nucleoles*, and the cyanophilous or *pseudo-nucleoles*. The latter belong to or replace the chromatic framework of the nucleus. The chromatic framework and its products—the nuclear filament and the separating filaments—are cyanophilous; the *eu-nucleoles*, the

* Arch. Sci. Phys. et Nat., xxviii. (1892) pp. 82–108 (1 pl.).

† Oesterr. Bot. Zeitschr., xlii. (1892) pp. 263–5.

‡ Beitr. z. Biol. d. Pflanzen (Cohn), v. (1892) pp. 443–59 (1 pl.).

spindle-, and uniting filaments, as well as the cell-plate and cytoplasm, are erythrophilous. The generative nucleus of the pollen-grain is cyanophilous, while the vegetative nucleus is erythrophilous. The ovum-nucleus and all the nuclei in the embryo-sac are erythrophilous, this character being evident even in the nucleus of the mother-cell of the embryo-sac. The phenomena correspond, therefore, altogether to those presented by the sexual nuclei of animals.*

Embryo-sac of *Arisæma*.†—Mr. D. M. Mottier describes the various stages in the development of the embryo-sac in *Arisæma triphyllum* (Aroideæ), which do not differ in any material point from the ordinary type in Monocotyledons. The mother-cell of the embryo-sac arises as a single hypodermal cell in the apex of the nucellus, and divides by longitudinal walls into two or three cells. One of these enlarges considerably, and divides by a transverse wall into two cells; the lower one of these is usually the larger, and absorbs the upper one, developing into the embryo-sac.

Two Endosperms in an Ovule of *Pinus*.‡—Prof. J. B. Farmer records the occurrence of two endosperms or prothallia in an ovule of *Pinus sylvestris*. They were separated by a well-marked wall running obliquely between them and continuous with the lateral walls of the cavity which contained them. The upper endosperm, that nearest the micropyle, was somewhat smaller than the lower, but both possessed perfectly developed archegones, and the protoplasm of the central cell in each archegone exhibited the frothy vacuolation characteristic of that of a normally formed corpuscle.

Flowers and Insects.§—Mr. C. Robertson describes the mode of insect-pollination in a number of American Umbelliferae. He states that in the proterogynous species of this order, the primary umbel consists only of male flowers, the proportion of hermaphrodite flowers increasing in umbels of the 2nd and 3rd orders; while, on the other hand, the proterandrous species commonly have the primary umbels composed entirely of hermaphrodite, and the last umbels entirely of male flowers.

Another paper|| by the same writer deals with a few American species belonging to the Saxifragaceæ, Grossulariaceæ, Onagraceæ, and Caprifoliaceæ.

Pollination of *Calla palustris*.¶—According to Dr. P. Knuth, the female flowers of *Calla palustris* are mature considerably earlier than the male flowers in the same spike. The uppermost female flowers may be pollinated by male flowers from the same spike; the lowermost must be cross-pollinated, and are in all probability anemophilous; no regular insect visitors were observed.

* Cf. this Journal, 1891, p. 714.

† Bot. Gazette, xvii. (1892) pp. 258-60 (1 pl.).

‡ Ann. of Bot., vi. (1892) pp. 213-4 (1 fig.).

§ Trans. Acad. Sci. St. Louis, v. (1892) pp. 449-60. Cf. this Journal, ante, p. 66.

|| Bot. Gazette, xvii. (1892) pp. 269-76.

¶ Bot. Centralbl., li. (1892) pp. 289-91.

(2) Nutrition and Growth (including Germination, and Movements of Fluids).

Relation between secondary Increase in Thickness and the Nutrition of Trees.*—Dr. A. Wieler treats in detail of these subjects, especially in relation to the diminution of the number of the vessels in the autumn wood, the conditions of elongation of the elementary organs of the wood, the increase in thickness of the cell-walls in the autumn wood, and its relation to the conditions of elongation. Three factors play their part in the nutrition of the tree, viz. the conduction of water, the supply of inorganic, and the supply of organic food-materials.

Autumn and Spring Flowering Plants.†—Mr. A. F. Foerste gives further details respecting the autumn-flowering plants of the South of Europe. In many cases the phenomenon is not the result of a second blossoming, but of an excessive tendency to blossom early. In a number of species the flower-buds blossoming in the autumn are protected in scaly bulbs or in subterranean buds until immediately before the flowering season. In many cases the blossoms are developed more or less before the leaves. Very frequently the fruit is not mature till the following spring, the fruiting ovary remaining beneath the ground through the winter, as in *Colchicum*. When there are a number of spring-flowering species in the same genus, one or more will always be found to commence flowering remarkably early, thus forming a link with the autumn-flowering species.

Passage of Substances out of Leaves in the Autumn.‡—Herr C. Wehmer contests the current statement that before the fall of leaves in the autumn there is a retreat of the nutrient substances contained in them to the branches. The error appears to have resulted from a wrong interpretation of the fact that the proportion of potash and phosphoric acid in the ash undergoes a great decrease in the autumn months. This however is largely due to the enormous increase of other substances, that of lime being to the extent of 1400, and of silica as much as 5000 per cent. The absolute decrease of potash and phosphates is very much less, and does not take place to any great extent before October, when the leaves are already dead, and a transfer of substances from cell to cell is impossible. It is largely due to solution by rain. The substances contained in the leaves are, it is true, used up again by the plant, but only after they have reached the soil, and there undergone the necessary transformations.

Radial Current of Sap in the Roots.§—Dr. P. Siedler has investigated the structure of the root of a very large number of Phanerogams and Vascular Cryptogams, with the view of determining the course of the radial current of sap. He finds that there is in many cases a special tissue, sharply differentiated from the rest of the cortical parenchyme, which especially regulates the centripetal current. This tissue consists

* Tharander forstl. Jahrb., xlii. (1892) 154 pp. and 2 pls. See Bot. Ztg., l. (1892) p. 511. Cf. this Journal, 1887, p. 776.

† Bot. Gazette, xvii. (1892) pp. 233-45. Cf. this Journal, ante, p. 389.

‡ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 152-63.

§ Beitr. z. Biol. d. Pflanzen (Cohn) v. (1892) pp. 407-42 (1 pl.).

of one or more layers lying immediately beneath the epiderm to which he gives the name "root-hypoderm." The outermost layer of this hypoderm, lying immediately beneath the epiderm, frequently consists of two different kinds of cell, shorter and longer, and may be compared to the "velamen" of the roots of the Orchidæ. The longer cells of this layer appear to serve the purpose of the absorption of the sap, the shorter ones that of the storing up of nutrient materials.

Apparatus for Determining the Periodicity of Root-pressure.*—Mr. M. B. Thomas has invented an apparatus for this purpose. It consists essentially of a tin cylinder with smoked surface, and a U-shaped tube containing mercury, on which floats an indicator which marks the smoked surface of the cylinder, the cylinder being made to revolve by means of clockwork. The apex of the cut stem of the plant is inserted into an inverted U-shaped tube, which is connected with the larger one; and the supply of water to the plant is maintained by means of an inverted flask, the tube of which touches the surface of the water in the dish in which the pot is placed. As the root absorbs water the pressure upon the column of mercury increases, and lifts up the indicator, which marks a continuous spiral line on the cylinder.

Assimilation of Free Nitrogen by Plants.†—Herr B. Frank deals in the present paper with the differences in this faculty displayed by different species, and with the value of the process in agriculture.

He points out that a clear distinction must be drawn in the first place between the power of a plant to accumulate nitrogen in an agricultural sense, and its power to assimilate free nitrogen from the air in a physiological sense. Those plants which are known as "nitre-plants" possess the former of these properties to a high degree, drawing large quantities of nitrogen from the nitrogenous compounds in the soil, but the latter property only to a small extent; while many leguminous plants, such as *Lupinus luteus*, display the latter characteristic very strongly, but the former hardly at all. Nitrogen-accumulating plants are those only which contain, when mature, more nitrogen than they can have obtained from the soil. Between these plants and those which consume nitrogen, a hard and fast line cannot, however, be drawn for practical purposes. The value of different soils for the accumulation of nitrogen by different species of plants is treated in detail.

The author repeats his assertion, and confirms it by further experiments, that the assimilation of free nitrogen from the air is a very widely distributed phenomenon in the vegetable kingdom, and is by no means confined to the Leguminosæ. It does not, however, take place until the vegetative organs have attained a considerable vigour. Neither leguminous nor non-leguminous plants contain in their seeds a sufficient supply of nitrogenous compounds to enable the seedling to reach that stage at which this direct assimilation of nitrogen takes place; and they are therefore dependent on the nitrogen compounds in the soil; or, in the case of the Leguminosæ, on the faculty which is imparted to them by the symbiotic fungus *Rhizobium Leguminosarum*. The author does

* Bot. Gazette, xvii. (1892) pp. 212-4 (1 pl.).

† Landwirthsch. Jahrb., xxi. (1892) pp. 1-44. See Bot. Centralbl., l. (1892) p. 269. Cf. this Journal, ante, p. 511.

not consider it certain that this assimilation of free nitrogen is effected directly by the fungus itself; it may rather be the result of an irritation of the host-plant by which its tissues are excited to more active powers.

Peas, red clover, and many other leguminous plants possess, therefore, the property, which is so valuable to agriculture, of returning to the soil, on the decay of their tissues, a larger amount of nitrogen than they have taken from it; and some non-leguminous plants have the same faculty, though to a much smaller extent.

Assimilation in the Sun and in the Shade.*—From a series of experiments made on several woody and herbaceous plants, M. L. Gêneau de Lamarlière states that, under the same external conditions the intensity of the decomposition of carbon dioxide varies in leaves of the same species, according to their conditions of development, the process being more energetic in those developed in the sunshine than in those developed in the shade.

Accumulation of Atmospheric Nitrogen by *Bacillus radicolica*.†—Fresh experiments on the inoculation of *Vicia Faba* by this microbe lead M. W. Beyerinck to the conclusion that, under favourable conditions as regards nutrition and temperature, there is a gain in the amount of nitrogen, though it is in all cases but slight. With the *Robinia* bacilli no positive results were obtained. Whether the nitrogen gained from the air was in the free or combined state is not certain, but the latter is the more probable. Some micro-organisms have the power of withdrawing nitrogen compounds from solutions so dilute that the roots of higher plants are unable to extract anything from them. The nitrogenous food of the Papilionaceæ must depend entirely on the dying off of the bacteria in the nodules, as only dead bacteroids seem able to give up as albumen the nitrogen they took up.

Periodicity of Transpiration.‡—Experiments made by Herr W. Broocks on a number of cultivated plants show that the dry substance of the green leaves of plants growing in the open air increases during the day in summer, except when the temperature is low and the sky cloudy. When the sky is clear the greatest increase takes place between 6 a.m. and 12, or between 10 a.m. and 2 p.m.; the hour between 11 and 12 generally showing the maximum of all. During the night there is always a decrease in the dry weight of the leaves, which is most rapid when the temperature is high. The greater part of this decrease takes place during the early part of the night.

Transpiration from the Flower.§—From experiments on *Galtonia candicans*, *Fuchsia coccinea*, and *Anemone japonica*, M. G. Curtel states that in the young condition of the bud transpiration is very strong, but decreases subsequently, reaching a minimum when the bud is about half developed. At this time the epiderm has become greatly thickened, and

* Comptes Rendus, cxv. (1892) pp. 368-70.

† Med. Kon. Akad. Wetens. Amsterdam, viii. pp. 460-75. See Journ. Chem. Soc., 1892, Abstr., p. 1019.

‡ 'Ueb. tägliche u. stündliche Assimilation einiger Cultur-Pflanzen,' Halle, 1892 (56 pp.). See Bot. Centralbl., li. (1892) p. 182.

§ Comptes Rendus, cxiv. (1892) pp. 847-9.

has developed a more or less thick and impermeable cuticle. After this the surface increases rapidly, the stomates are formed when there are any, and transpiration increases considerably. It attains its maximum when the flower opens, and continues without diminution during the withering of the flower, until it is dead. During this last period, however, the evaporation is not true transpiration, since it depends on the permeability of the protoplasmic utricle for the enclosed water.

Intramolecular Respiration of Plants.*—From experiments made on wheat, and on *Lupinus luteus*, Herr W. Detmer has obtained the following results:—

Intramolecular, like normal respiration takes place actively at the freezing-point, and may even proceed at a temperature of -1.5 to -2° C. The amount of carbon dioxide given off increases with the temperature, but the curve is not the same as that for normal respiration. For normal respiration the most rapid increase takes place, in wheat at 25° , in the lupin at 30° C.; for intramolecular respiration in both plants at 40° C. The optimum temperature for both kinds of respiration is 40° . The production of carbon dioxide is always less, with both plants, for intramolecular than for normal respiration.

Respiration of the Potato.†—Prof. J. Boehm confirms his previous observation that freshly injured potatoes respire very much faster than the uninjured tubers. This appears to be the result of a feverish state of activity caused by the wound, rather than by an increase in the amount of oxygen which enters the tissues. More energetic respiration is caused by a greatly increased or a greatly lowered temperature, by remaining long in pure oxygen, and by the attacks of the parasitic fungus *Phytophthora infestans*. These facts militate, in the author's opinion, against the theory that the solution of starch is due to the action of diastase.

(3) Irritability.

Nutation of the Flower-stalk in Papaver, and of the End of the Shoot in Ampelopsis.‡—According to Dr. M. Scholz the curvature of the bud-stalk of *Papaver* (various species were observed) is not the result of the weight of the bud, but of positive geotropism. The tension of the cortical layer is negative, that of the pith positive. The curvature depends on unequal growth of the sides, and is therefore an example of nutation. The part of the flower which determines the geotropism of the stalk is the pistil; if this is removed, the stalk becomes negatively geotropic. Moreover, the determining force is the formation of the ovules; if these are removed the nutation ceases. As soon as the ovules are fully developed, the nutation also ceases, the stalk becoming negatively geotropic.

The cause of the curvature of the extremities of the tendrils of the Virginian creeper is also positive geotropism, the seat of the geotropism being the portion of the shoot that is bent in a semicircle. It ceases if

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 201-5.

† SB. K. K. Zool. Bot. Gesell. Wien, xlii. (1892) pp. 47-9. Cf. this Journal, 1888, p. 85.

‡ Beitr. z. Biol. d. Pflanzen (Cohn) v. (1892) pp. 373-406 (1 pl.).

the terminal bud is removed. The same is the case with the tendrils of the vine. In both these cases, as well as in the flower-bud of *Papaver*, we have examples of anisotropy, one portion of an organ growing in exactly the opposite direction to the remainder of the same organ.

Electrical Currents in Plants.*—Herr O. Haacke has made a series of observations on plants belonging to different sections of flowering and flowerless plants, with the view of determining the causes of the electrical currents which so commonly exist between one part of the plant and another. His conclusion is that these currents depend mainly on the various processes of metastasis, and especially on the assimilation of carbon dioxide and elimination of oxygen. The movements of water may take some part, but only a subordinate one, in causing these currents.

(4) Chemical Changes (including Respiration and Fermentation).

Chemical Researches on Germination.†—M. E. Belzung has studied, in certain plants (*Lupinus albus* and *luteus*, *Cicer arietinum*, *Cucurbita Pepo*, &c.), the nature of the essential products resulting from the germination of the seed, keeping in view more particularly the intracellular crystallization of the principles normally contained in solution in the sap of the living cell. All the crystallizations were effected by the simple method of enclosing the living tissues in pure glycerin; this reagent, giving rise to a more rapid exosmosis of water than of the dissolved crystalline substance, brings the sap more or less rapidly to the point of saturation, and thus brings about the intracellular precipitation.

An account is given of the most abundant crystallizable substances contained in young plants of the various species examined. Only one, asparagin, was found in all, its proportion in the different species being in an inverse ratio to that of starch. The other nitrogenous organic principles found, amides, alkaloids, &c., are, like asparagin, the result of the metamorphosis of reserve albuminoid substances, each species having generally its own special substance. But the metamorphosis of these substances gives rise also to purely mineral compounds, such as nitrates and sulphates, the nitrogen and sulphur returning to their original mineral form. The author believes that the sulphates of germination are the result of a process going on within the plant which may be called sulphuric fermentation, just as the nitrates are the result of a nitric fermentation, and that the action of the atmospheric air is indispensable for the process.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Prothallium and Embryo of Marsilea.‡—Prof. D. H. Campbell describes in detail the structure of the fruit, of the microspore and

* Flora, lxxv. (1892) pp. 455–87 (4 figs.).

† Ann. Sci. Nat. (Bot.), xv. (1892) pp. 203–62 (2 pls.); and Journ. de Bot. (Morot), vi. (1892) pp. 49–53 (2 figs.).

‡ Proc. California Acad. Sci., iii. (1892) pp. 183–205 (2 pls.). Cf. this Journal, ante, p. 642, and 1890, p. 637.

the male prothallium, of the megaspore and female prothallium, and of the embryo of *Marsilea vestita*, including the development of the cotyledon, the stem, and the root.

The antherozoids of *Marsilea* are distinguished from all others by the great number of coils in the spiral body, which may be as many as 13 or 14; the cilia and the vesicle which is attached to the hinder end are derived from the cytoplasm. The antherid differs from that of *Pilularia* mainly in the less perfect development of the dome-shaped wall in the mother-cell, and in the more distinct separation of the two groups of antherozoid-cells. The megaspore is the most specialized found among the Pteridophytes. The embryo shows the closest resemblance to that of *Pilularia*, but also agrees closely with that of the Polypodiaceæ.

With regard to the systematic position of the Marsileaceæ, the author adheres to his previous views that they represent the end terms of a series of forms whose lower members are found among the leptosporangiate ferns, and probably the Polypodiaceæ. *Marsilea* stands at the top and is the most specialized, with *Pilularia* between it and its homosporous relations. With the Salviniaceæ there is little in common; the leaf, stem, and root grow in the same way as those of the Polypodiaceæ, the leaves having even the peculiar circinate veneration of those of ferns. The development of the sporangium agrees also in the principal details with the Polypodiaceæ, and the early divisions of the embryo correspond almost exactly with those in that group. The first leaf in *Marsilea* is simple, like the permanent form in *Pilularia*; and it is not till several leaves have been developed that the characteristic quadripartite form appears.

Spores of Ferns.*—Dr. H. Fischer proposes a classification of fern-spores according to the structure of the membrane, which always consists of two layers, an endospore composed of cellulose and a cuticularized exospore, while a third outermost layer or episporium is rarely wanting. The differences depend on the occasional absence of the episporium and on the relative thickness, colour, and structure of the other two membranes.

Salts in *Angiopteris evecta*.†—MM. E. Belzung and G. Poirault find that the abundant sap in the petiole of this fern, when treated with alcohol, yields crystals of calcium malate, accompanied by monoclinic calcium oxalate. Sulphates and phosphates are also present in the soluble form, as well as tannic acid.

Apical Growth of the Stem and Development of the Sporangium of *Botrychium*.‡—Mr. C. L. Holtzman finds that in *Botrychium virginianum* the stem grows by means of a distinctly recognizable three-sided pyramidal cell. The sporangium is first noticed as a cell of large size, but not protruding beyond the other cells; and it is probable that the entire sporangium can be referred to this single large cell, indicating a closer connection with the leptosporangiate group than has been generally supposed. The origin of the archesporium is also more deeply seated than in the true Filices. The author derives the conclusion that the Ophioglossaceæ are among the more recent families of Ferns.

* JB. Schless. Gesell. Vaterl. Cultur, lxi. (1892) pp. 130-1.

† Journ. de Bot. (Morot), vi. (1892) pp. 286-98 (4 figs.).

‡ Bot. Gazette, xvii. (1892) pp. 214-7 (1 pl.).

Fructification of *Sphenophyllum*.*—From an examination of the fertile spikes of *Sphenophyllum cuneifolium* from the Valenciennes basin, M. R. Zeiller identifies with it the *Volkmania Dawsoni* of Williamson. He finds that the sporanges correspond in almost every point except their smaller size, with the sporocarps of *Marsilea*; and he suggests that *Sphenophyllum* must be constituted into a distinct class of Vascular Cryptogams, most nearly allied to the Rhizocarpeæ, though resembling the Lycopodiæ in the structure of their axis. Binney's genus *Bowmanites* must be sunk in *Sphenophyllum*.

Algæ.

Trichomic Structures in Algæ.†—According to Prof. M. Moebius, trichomic structures (in which term attaching rhizoids are not included) occur in all the main divisions of Algæ, and vary greatly in their structure and development. They are found in all the sections of Floridæ. In *Batrachospermum vagum* each hair consists of a long cylindrical cell, proceeding from a lateral or terminal outgrowth of the supporting cell. The outermost layer of the wall is finally burst, and forms a kind of sheath at the base of the hair. If the point is broken off, a new hair develops within this tube from the supporting cell. In the Phæophyceæ hairs are also very widely distributed. In *Laminaria digitata* peculiar paraphyses occur in the middle of the sori. They are unicellular, and the cell-cavity is closed by a mucilaginous plug. In the Chlorophyceæ structures of this kind occur especially in *Cedogonium*, *Coleochæte*, and *Bulbochæte*. The bristles of *Coleochæte* are outgrowths of the supporting cell, but are not cut off from it by a septum. The outer layer of the membrane in this case also bursts, and surrounds the base of the hair in the form of a sheath.

Fructification and Thallus of Floridæ.‡—Prof. F. Schmitz makes some small corrections in his published descriptions of the sexual organs in Floridæ. In *Callithamnion* the two auxiliary cells are impregnated by conjugation with the nearest small daughter-cells of the fertilized ovum-cell. A slight correction is made in the description of the formation of the procarp in the Rhodomelaceæ. It is not the case that in *Chondrus* the cells of the meta-ooblast filaments conjugate with the cells of the adjacent sterile tissue, and that from this conjugation the group of spores is developed; but this is a correct description of the process in *Mychodea*.

Prof. Schmitz further confirms his previous statement that the thallus of Floridæ is in general composed of branched filaments which grow by continuous acropetal septation of the apical cell. This is true in a very large number of cases, though exceptionally a septum may arise here and there in a cell which is not apical. In some instances also such intercalary growth is normal, as in many Corallinaceæ, and in all genera and species of Nitophylleæ that have been examined.

Systematic Position of *Thorea*.§—Prof. F. Schmitz adduces arguments against Moebius's view that *Thorea* belongs to the Floridæ rather

* Comptes Rendus, cxv. (1892) pp. 141-4.

† Biol. Centralbl., xii. (1892) pp. 71-87, 97-108 (8 figs.).

‡ La Nuova Notarisia, iii. (1892) pp. 110-9.

§ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 115-42. Cf. this Journal, ante, p. 239.

than to the Phæophyceæ. The most important factor, he considers, in determining the systematic position of an alga, is the nature and mode of development of the organs of reproduction, and no sexual organs have yet been discovered in *Thorea*. The only reproductive organ known, the monosporange, presents, it is true, the greatest resemblance to similar organs in *Chantransia* and *Batrachospermum*; but single motionless spores are also known among the Phæophyceæ (Tilopterideæ), and even among the Chlorophyceæ. The mode of growth of the shoot, on the other hand, by intercalary elongation, with interposition of newly formed filaments, resembles nothing that is known among Florideæ, and points to some quite different affinity; while a somewhat similar mode of growth is to be found amongst both Phæophyceæ and Chlorophyceæ. He does not find in *Thorea* the "Florideæ-starch" stated by Moebius to occur there; and lays but little stress on the resemblance in colour. On the whole the author prefers to consider *Thorea* as the type of an independent group presenting greater affinity with the Phæophyceæ than with the Florideæ. It may very probably have sprung from the Mesogloieæ. A new species, *T. Zollingeri* from Java, is described.

Prof. M. Moebius* replies to these arguments, and reiterates the reasons for placing *Thorea* among the Florideæ; these are derived from the resemblance to *Batrachospermum* in the mode of formation of the spores, from the colouring of the chromatophores, which resembles that of the Florideæ, and from the presence of a substance in the cells, "Florideæ-starch," which is coloured brown by iodine.

Schmitziella, a new Genus of Corallinaceæ.†—Mr. E. A. L. Batters describes a new species and genus of endophytic algæ growing on *Cladophora pellucida*, to which he gives the name *Schmitziella endophlæa*. The following is the diagnosis of the genus:—Thallus haud incrustans, endophytus, planus, membranaceus, pseudo-parenchymaticus, venosus; fructus sub cuticula *Cladophoræ* in pustulis conceptaculiformibus hemisphærico-depressis apice poro pertusis elevata evolentes, sparsi, minuti, pericarpio proprio clauso orbati, soros nematheciosos formantes. Thalli nervis primariis e cellulis elongatis pluro-seriatis (2-8), longe excurrentibus formatis, secundariis monosiphoniis pinnatim egredientibus, alternis, una cum precedentibus reticulum efficientibus, maculæ ejus cellulis (ramulis) irregularibus plus minus densis implentur. Et carposporis et sphærosporis paraphysibus paucis immixtis; sphærosporis oblongis, zonatim divisis. Antheridiis ignotis. The essential points of structure place it undoubtedly among the Corallinaceæ.

Ægagropilæ.‡—By this name Prof. G. v. Lagerheim designates those marine algæ which assume a more or less spherical form, and are in this condition driven about freely in the sea. In those hitherto recorded each mass consists of a single individual which has developed in all directions. Among Florideæ only a few examples are known:—*Fastigiaria furcellata* var. *ægagropila*, and possibly some species of *Lithothamnion*. Among Phæophyceæ there is only a single known instance,—*Sphacelaria cirrhosa* var. *ægagropila*. In the Chlorophyceæ they are much more

* Tom. cit., pp. 266-70.

† Ann. of Bot., vi. (1892) pp. 185-94 (1 pl.).

‡ La Nuova Notarisia, iii. (1892) pp. 89-95.

common, including several species of *Cladophora*, *Valoniaægagropila* and *confervacea*, and *Codium mamillosum*. Of Cyanophyceæ may be mentioned *Stigonema ocellatum* β *globosum*, and *Hapalosiphon pumilus* β *globosus*. In addition to these, Prof. Lagerheim describes a form of a *Chætomorpha* allied to *C. crassa*, which forms similar dense globular floating masses composed of a large number of filaments interwoven together.

Ectocarpus siliculosus.*—Herr P. Kuckuck describes a variety of this alga, on which he bestows the name var. *varians*, distinguished by the remarkable variation in the form and size of the plurilocular sporanges. They are either bluntly cylindrical, two or three times as long as broad, with bulging chambers, or cylindrico-spherical, or greatly elongated, and either sessile or stalked, terminal or intercalary. The chromatophores agree with those of the normal form, lying in several not unfrequently branched bands on the cell-wall. The variety grows intermixed with the typical form, and there are all intermediate stages between them.

Saccorhiza.†—Mr. W. A. Setchell has investigated the life-history of *Saccorhiza dermatodea*, and finds that it agrees with the Laminariaceæ in its general structure. The permanent organ of attachment originates from a special organ, the *rhizogen*, which produces two successive rows of hapters; the first organ of attachment or primitive disc is only temporary. The cryptostomates, as well as the tufts of hairs, spring from a level surface in the young fronds; in the parts where the structure is more complex they occupy the base of cup-shaped depressions which are finally bordered by a prominent margin. The pith is surrounded by filaments arranged as in other genera of the order: special sclerenchymatous fibres are developed in the pith of the stipe and leaf. The paraphyses do not possess the curious terminal appendage characteristic of the greater part of the Laminariaceæ. The process of development resembles that of rejuvenescence in the Laminariaceæ. There are no cryptostomates in the adult frond.

Non-nucleated Cells in the Conjugatæ.‡—M. J. Gerassimoff states that the peculiar state of some species of *Spirogyra* and *Sirogonium*, in which, of two neighbouring cells, one has two nuclei and the other none, may be induced by exposure to a low temperature. The sister-cell of a non-nucleated cell may, however, contain only a single nucleus, either simple or compound. When there are two nuclei, they always take up a position exactly opposite to one another. Non-nucleated cells may also be formed, in these two genera of Conjugatæ, in quite a different way, by a cell dividing at once into three cells from the simultaneous appearance of two parallel septa.

Glaucozystis.§—Herr G. Hieronymus has studied the structure and mode of propagation of the rare organism *Glaucozystis Nostochinearum*. He finds that, even in the mature plant, the chromatophores have the

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 256-9 (1 pl.).

† Proc. Amer. Acad. Sci., xxvi. (1891) pp. 177-217 (2 pls.).

‡ Bull. Soc. Imp. Nat. Moscou, 1892, pp. 109-31 (9 figs.). Cf. this Journal, 1892, p. 614.

§ Beitr. z. Biol. d. Pflanzen (Cohn), v. (1892) pp. 461-71 (1 pl.).

remarkable appearance of spiders' legs springing from a central body. The "legs" vary in number from ten to twenty; they are from 1.5 to 2.5 μ thick, and are bent to about a semicircle. They contain in them structures of the nature of "grana." They all radiate from a clear disc-shaped spot in the centre of the cell. A nucleus is present, not in the clear spot, but beneath it; and it is of a much higher organization than the so-called "nucleus" of most Phycocromaceæ. It contains a structure resembling a nucleole. The organism is propagated by division of the nucleus, usually into four or eight, the chromatophores dividing also at the same time. From the complexity of its structure, the author considers that *Glaucocystis* must be removed from the Phycocromaceæ, and be placed, together with *Chroothoece*, *Cyanoderma*, and *Phragmonema*, in a special family of GLAUCOCYSTIDÆ, possibly allied to the Bangiaceæ.

New Species of Phyllosiphon,*—Prof. G. v. Lagerheim describes the three following new species of this genus of epiphyllous algæ from Ecuador, viz.:—*P. maximus* on leaves of a species of *Arisarum*, forming patches from 15–60 mm. in diameter; *P. Philodendri* on leaves of a species of *Philodendron*; *P. Alocasiæ* on leaves of a species of *Alocasia*.

New Freshwater Encrusting Alga.†—MM. J. Huber and F. Jadin make an addition to Bornet and Flahault's list ‡ of algæ which perforate calcareous shells, in a new species of *Hyella*, *H. fontana*, belonging to the Chamæisiphonaceæ, found in clear running water on calcareous stones and old snail-shells, and growing in association with another freshwater alga, probably a *Chantransia*, and with *Plectonema terebrans*. As this species differs from the one already described in several particulars, the authors propose the following amended diagnosis of the genus *Hyella*:—Thallus filamentis ramosis constitutus; ramificatio vera; articuli disjuncti, i. e. in trichomate continuo Nostochacearum hormogonearum modo non catenati, inferiores breves, haud raro longitudinaliter divisi, superiores longiores; heterocystæ nullæ; propagatio fit per cellulas vegetativas e divisione cellularum collateralium plus minusve protracta ortas, demum vagina communi liberatas, et per sporas in sporangiis evolutas, cytoplasmatis divisione succedanea formatas.

Fossil Permian Algæ.§—MM. C. E. Bertrand and B. Renault describe a structure from the bituminous Permian beds of Autun which they regard as the remains of an alga not higher in scale than the Chroococcaceæ or Pleurococcaceæ, and to which they give the name *Pila bibractensis*. The thallus is elliptical and multicellular, and probably lived in the brown waters at the moment of formation of the bituminous shales.

Fungi.

Pigments of Fungi.||—Herr G. Nadson gives an account of the reactions with solvents and other chemical reagents, and of the influence

* La Nuova Notarisia, iii. (1892) pp. 120–4 (1 pl.).

† Journ. de Bot. (Morot), vi. (1892) pp. 278–86 (1 pl.); and Comptes Rendus, cxv. (1892) p. 262–4.

‡ Cf. this Journal, 1890, p. 365.

§ Comptes Rendus, cxv. (1892) pp. 298–301.

|| Arb. St. Petersburg. Naturf.-Ges. (Bot.), 1891, pp. 132–76. See Bot. Centrabl., 1. (1892) p. 108.

of light, temperature, and oxygen, as well as of the spectroscopic properties, of the following fungus-pigments:—the pink pigment of the pileus of *Russula integra* and *vesca*, the red of the pileus of *Amanita muscaria*, the orange-red of *Paxillus involutus*, the yellow of the cortex of *Æthelium* and of the ripe receptacle of *Lycogala epidendron*, the dark violet of the spores of *Fuligo varians*, the yellow of *Pholiota flammans* and of *Cantharellus cibarius*, the yellow of the hymene and the yellow-brown of the surface of the pileus of *Boletus xereus*, the yellow-brown or red-brown of *Polyporus igniarius*, the orange-brown of *Limacium pratense*, the red or orange-yellow of *Lactarius deliciosus*.

The author classifies the known pigments of fungi under the three following heads:—(1) *Hydrochromes* (pigments of *Russula* and of *Amanita muscaria*). These are readily oxidized and reduced, easily decomposed by light, soluble in water, insoluble in 95 per cent. alcohol, and are fluorescent; they occur on the surface of the fungus and in the membranes of the hyphæ. (2) *Lipochromes*. None of this group occur in the pigments examined by the author. (3) *Excreta*. The greater number of the pigments of fungi are certainly or probably of this character; they are not destroyed by light, and are distinguished from those of the first two groups by their greater stability. They often occur in the cell-cavity, often outside the membranes of the hyphæ, but by far the greater number are incrustations of the membranes themselves.

Pythium Sadebackianum, a Disease of Peas.*—Herr L. Wittmack describes a disease of peas caused by a new species of *Pythium* nearly allied to *P. De Baryanum* and *P. Equiseti*. It attacks the lower part of the stem, and the root, but especially the root-tubercles. It forms sporanges within the tissue, each containing a single spore.

Cladosporium herbarum.†—Herr G. Lopriore describes the destructive effects on corn-crops of attacks of *Dematium pullulans*, a conidial form of *Cladosporium herbarum*; it causes the disease known as "Taumelgetreide," which shows itself as black streaks on the grains; and it also produces, under certain conditions, chlamydospores with thick brown walls.

Fungus-diseases of the Tomato and of the Date-palm.‡—MM. E. Prillieux and Delacroix describe a very destructive epidemic of the tomato produced by *Cladosporium fulvum*; it makes its appearance as yellow spots on the under side of the leaves.

The same authors find that the long-known parasite of ripe dates, described as *Ustilago Phœnicis*, is a species of *Sterigmatocystis* nearly allied to *S. nigra*. A full diagnosis of *Sterigmatocystis Phœnicis* is given.

Diseases caused by Fungi.§—Mr. J. E. Humphreys describes a number of diseases of cultivated crops caused by fungi:—A disease of

* Mttl. d. Ver. z. Förderung d. Moorcultur, 1892. See Bot. Centralbl., 1892, Beih., p. 316. † Ber. Deutsch. Bot. Gesell., x. (1892) pp. 72-6.

‡ Bull. Soc. Mycol. France, vii. (1891) pp. 19-20, 118-20 (1 pl.). See Bot. Centralbl., li. (1892) p. 121.

§ Report on Plant-diseases, No. 23, pp. 218-48 (1 pl.). See Bot. Centralbl., 1892, Beih., p. 307.

lettuces produced by a species of *Botrytis* (*Polyactis*). The mildew of cucumbers, caused by *Erysiphe Cichoriacearum*. A new disease of potatoes which attacks the leaves, and is due to a *Macrosporium*. A second cucumber-fungus belonging to the genus *Acremonium*. The mildew of celery, caused by *Cercospora Apii*. Two parasites of clover, *Uromyces Trifolii* and *Polythrincium Trifolii*. A disease of the black poplar, due to *Melampsora populina*. An anthracnose of the chestnut, produced by *Marsonia ochroleuca*.

Meliola.*—M. A. Gaillard publishes a monograph of this genus of foliicolous Perisporiaceæ, of which he enumerates 109 species, a considerable number of them new. The genus is divided into two sections; in the first, characterized by the asci being ovoid or globular, which includes by far the greater number of the species, they are again classified according as the spores are divided into 2, 3, or 4 chambers. The second section, in which the asci are club-shaped or cylindrical, includes only 3 species; in one of these the spores have 3, in another 4, and in the third 5 chambers.

Sclerotes of Vaccinium and Rhododendron.†—Herr E. Fischer describes the sclerotes produced on *Vaccinium Myrtillus* and *vitis-idea* by *Sclerotinia Vaccinii* and *baccarum*; also a very similar one on the fruits of *Rhododendron ferrugineum* and *hirsutum*, caused by an allied fungus to which he gives the name *Sclerotinia Rhododendri*.

Germination of Teleutospores of Ravenalia.‡—Mr. B. M. Duggar describes the little-known germination of the teleutospores of *Ravenalia cassiæcola*. It differs from that of such typical genera as *Puccinia* in the non-septate character of the promycele, which obtains in all species except those in which germination takes place in abundance of water. The sporidia are produced at or very near the end of the promycele, and in lateral branches which have the usual characters of sterigmas.

Puccinia Agropyri.§—Herr P. Dietel identifies this uredo-form, parasitic on *Agropyrum glaucum*, with *Æcidium Clematidis*, parasitic on *Clematis Vitalba*, and not with *Melampsora populina*, as suggested by Ráthay.

Macrosporium sarcinæforme Cav.||—Sig. F. Cavara describes a new parasite of red clover which was discovered in the neighbourhood of Pavia. Very slender uncoloured septate hyphæ grow into the parenchyme of the leaf and produce at first uncoloured, afterwards brownish-yellow spots. On the under side of the leaf hyphæ grow out, and from these are formed conidiophores 1.4–1.8 μ long. The apical cell enlarges and assumes the form of a ball, in which transverse and horizontal partitions appear. If the spots are numerous they may unite, and the leaf withers away, so that fields attacked by this parasite are

* 'Le genre Meliola,' Paris, 1892, 164 pp. and 24 pls. See Bull. Soc. Bot. France, xxxix. (1892), Rev. Bibl., p. 76. Cf. this Journal, *ante*, p. 652.

† Mitl. Naturf. Gesell. Bern, 1891, 2 pp.; see Bot. Centralbl., 1892, Beih., p. 315. Cf. this Journal, 1889, p. 263.

‡ Bot. Gazette, xvii. (1892) pp. 144–8 (2 pls.).

§ Oesterr. Bot. Zeitschr., xlii. (1892) pp. 261–3.

|| La Difesa dai parassiti, 1890, No. 4. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) p. 705.

striking from their brown colour. To remedy this disaster the author advises that the clover should be kept under careful observation, in order that what becomes affected should be cut down and destroyed at the first appearance of the disease.

The characters of the new *Macrosporium* are as follows:—*M. sarcinæforme* sp. n. Hyphis sterilibus in parenchymate foliaceo repentibus, hyalinis, ramosis, septatis, hyphis fertilibus e stomatibus egredientibus, brevibus, erectis, rigidiusculis, parce septatis, nodulosisque, bruno-olivaceis, sporis (conidiis) sarcinæformibus, medio constrictis, transverse et longitudinaliter septatis, concoloribus, levibus, $24-28 \times 12-18 \mu$.

Botrytis tenella.*—M. E. Lecœur has succeeded in inoculating two of the largest apple plagues, *Anthonomus pomorum* and *Cheimatobia brumata*, with the fungus which has recently been used successfully against the cockchafer grub. The author inoculated pupæ living in the ground under the apple trees with a pure cultivation, and his first experiments were so successful that he believes that *Botrytis tenella* may be used to exterminate both insects.

Differences between *Oidium albicans* and *Oidium lactis*.†—Herr A. Weidenbaum found that the form of the Soor fungus varied with the consistence and composition of the substratum. In fluid media, not containing sugar or dextrin, it deposits a cloudy sediment which is composed of long branched or simple filaments; these filaments develop by extension from the "conids," and then again form by budding new "conids." If the fluid contain glucose or dextrin the sediment formed is powdery, and this is composed of yeast-like cells which multiply by budding. On solid media without glucose or dextrin both forms are found together, the yeast-like predominating at the surface, the filamentous at the bottom. The macroscopical appearance of puncture cultivations on meat-pepton gelatin varies according as the latter contains or not glucose or dextrin. On the other hand the form of *Oidium lactis* is perfectly constant and independent of any of the foregoing conditions. The macroscopical appearance of puncture cultivations is constant and different in appearance from the cultures of *O. albicans*.

The physiological differences are as follows:—*O. albicans* never, under any circumstances, liquefies gelatin. Its optimum temperature is 37° C. In media containing glucose it eventually produces traces of alcohol. *O. lactis* is able to liquefy gelatin if this have an acid reaction; its optimum temperature is 20° , and after two weeks it produces notable quantities of alcohol. Other differences relative to pathogenic properties are well known.

Fungi of Fruit-trees.‡—Sig. F. Cavara, after enumerating the diseases of fruit-trees observed at the cryptogamic laboratory of Pavia,

* Bull. Soc. Mycol. France, viii. (1892) pp. 20-1. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) p. 772.

† Arb. St. Petersburger Naturf. Gesell. (Bot.), 1891, pp. 26-8. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 569-70.

‡ L'Agricoltura Italiana, xvi. (1890) pp. 1-11. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 705-6.

and at the station for diseases of plants at Rome, proceeds to discuss certain fungi.

(1) *Monilia cinerea* Bon. is found as a parasite on the flower stems of pears, and kills the flower-buds.

(2) *Didymaria prunicola* sp. n. This new parasite grows on plum-leaves, which are covered with numerous round dry spots. On microscopical examination numerous fungus filaments are seen between the cells of the tissue of the leaves, and penetrating within by means of short ramifications. Separate hyphæ grow out from the under side of the leaf, and produce conidiophores, which form simple two-celled unbranched filaments with a two-celled elliptical or egg-shaped spore at the apex. The spores measure 12-17 μ in length and 5-9 μ in breadth, the length of the conidiophore being 120-220 μ and its breadth 2.5-3 μ . The pathogenic character of the fungus was not proved experimentally. The author recommends sulphur as a remedy.

(3) *Cladosporium condylonema* Pass. also produces a spotty disease of plum-leaves and damages the tree by causing the leaves to fall off too soon. Collection and destruction of the fallen leaves, as well as the use of sulphur, and sprinkling with sulphate of copper are recommended by the author.

(4) *Septoria effusa* Desm. This rare fungus causes the leaves of the sweet cherry to wither.

Verrucaria consequens.*—M. C. Bommer describes in detail the structure of this marine lichen, found on shells of *Balanus*, and believes it to be the result of the symbiosis of an alga, *Hyella cæspitosa*, with two distinct fungi, Bornet's *Ostracoblabe implexa* and a species of *Pharcidia*, belonging to the Pyrenomycetes, of which the peritheces and asci were detected. The author appends a list of marine lichens at present known which are entirely submerged, viz. *Verrucaria maura*, *V. antricola*, *V. microspora*, *V. littoralis* vars. *consequens* and *halodytes*, *V. leptotera* var. *marmorans*, and *Lichina pygmæa*; and of others which are partially submerged, viz. *Lecanora prosechoides*, *L. murorum*, *L. marina*, *Aspicilia gibbosa*, *Lecidea alboatra* var. *glaucoatra*, *Verrucaria scotina*, *V. marinula*, and *Lichina confinis*.

Sulphuretted-hydrogen-forming Yeast.†—M. Crouzel describes a yeast, forming sulphuretted hydrogen, which thrives only in acid or neutral solutions, dying in alkaline. A useful medium is urine after the ammoniacal fermentation has ceased, and to which sulphuric acid in quantity just sufficient for neutralization has been added. Sulphuretted hydrogen and allied compounds are produced by this yeast. Access of air must however be prevented, otherwise the fermentation products are reduced to sulphates, apparently through the agency of mould fungi which spread themselves over the surface of the cultivation. To cold, high temperatures, and drying the yeast is extremely sensitive, and is easily killed thereby. In sugar solution it produces only a little alcohol, but no inconsiderable quantity of lactic acid.

* Ann. Soc. Belge Microscopie, xvi. (1892) pp. 79-99 (1 pl.). Cf. this Journal, ante, p. 242.

† L'Union Pharmaceutique, xxxiii. (1892) p. 60. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 800-1.

M. F. Gay* asserts that Crouzel's sulphuretted-hydrogen-forming yeast does not exist. Ordinary beer yeast soon dies in gypsum water. The formation of sulphuretted hydrogen is to be ascribed to the agency of bacteria and fungi by which the yeast cultivation had been infected.

Effect of the Rays of the Sun on *Saccharomyces*.†—According to M. V. Martinand, grapes gathered from the lower part of a branch have, on their surface, a larger number of *Saccharomyces*, especially of *S. apiculatus*, than grapes gathered from the middle or upper part of the same branch. This is owing to the retarding influence which the rays of the sun, both the calorific and the luminous, exercise on the development of these organisms. The lower bunches of grapes are both more shaded than the upper ones, and are also nearer to the soil, which contains enormous quantities of *S. apiculatus*.

Infection by Uredineæ.‡—Mr. C. B. Plowright has succeeded in infecting *Betula alba* with *Cæoma Laricis*, producing the uredo-form *Melampsora betulina*. A new species of *Melampsora*, *M. repentis*, was cultivated on *Salix repens*, the æcidio-form of which is *Cæoma Orchidis* parasitic on *Orchis maculata*.

Loverdo's Cryptogamic Diseases of Cereals.§—M. J. de Loverdo publishes a very useful epitome of all that is known with regard to the various cryptogamic parasites which attack cereals. The structure and life-history of each fungus is described in detail, followed by an account of the effect produced on the host, and of the various remedies which have been proposed.

New Fungus-parasite of the Maple.||—Prof. R. Hartig describes a very destructive disease of the maple due to the attacks of a hitherto undescribed fungus to which the name *Septogloeum Hartigianum* has been given. The attacks are almost confined to branches of the first year. The mycele attacks the bark, medullary rays, and xylem-vessels.

Black-rot.¶—Dr. E. Ráthay gives a full account of this disease of the vine, caused by *Læstadia Bidwellii*, imported from America into Europe, of its life-history, of the injuries caused by it in the host-plant, and of the means of combating it. The mycele develops in the interior of the organ attacked, the young branches and berries, and produces spermogones and pycnids in the course of the summer. It is especially by the pycnosporos that the fungus is disseminated. Towards the end of the period of growth sclerotes are formed, usually within the pycnids, and from these conidiophores spring. Peritheces are also formed in May and June on the fallen diseased berries of the previous year.

* L'Union Pharmaceutique, xxxiii. (1892) p. 117. See Centralbl. f. Bakteriologie u. Parasitenk., xi. (1892) p. 801.

† Comptes Rendus, cxliii. (1891) pp. 782-4. Cf. this Journal (1891) p. 643.

‡ Zeitschr. f. Pflanzenkrankheiten, i. (1892) pp. 130-1.

§ 'Les maladies cryptogamiques des céréales,' Paris, 1892 (35 figs.). See Bull. Soc. Bot. France, xxxix. (1892) Rev. Bibl., p. 97.

|| Forst.-wiss. Zeitschr., 1892 (1 fig.). See Bull. Soc. Bot. France, xxxix. (1892) Rev. Bibl., p. 95.

¶ 'Der Black-rot,' 34 pp. and 19 figs. See Bot. Centralbl., 1892, Beih., p. 312. Cf. this Journal, ante, p. 84.

New American Helicosporæ.*—Mr. A. P. Morgan describes a new genus of Helicosporæ, a group of Hyphomycetes, *Helicoon*, with the diagnosis,—Hyphæ various; spores very large, spirally coiled into an elongated ellipsoidal body; and the following new American species,—*Helicomycetes gracilis*, *H. bellus*, *H. scandens*, *H. clarus*, *H. elegans*, *Helicoma larvale*, *H. ambiens*, *H. polysporum*, *H. repens*, *H. limpidum*, *H. ambiguum*, *Helicoon sessile*.

Cortinarius.†—Herr M. Britzelmayr gives a monograph of this genus of Agaricineæ, which he divides into the subgenera Phlegmacium, Myxadium, Inoloma, Dermocybe, Telamonia, and Hydrocybe.

M. Boudier ‡ describes a peculiar form of *Cortinarius scutulatus*, with all the habit of a *Morchella*, the surface being covered with deep pits, on the margins of which were isolated filaments, giving the pileus a woolly appearance.

Hydnum Schiedermayri, a Parasite of the Apple.§—Dr. F. v. Thümen describes this little-known disease of the apple-tree, which imparts a light greenish-yellow colour to the wood, and is distinguished by a characteristic odour of anise.

Rabenhorst's Cryptogamic Flora of Germany (Fungi).—Parts 37 and 38 of this publication continue the accounts of the Pezizaceæ. The Pyrenopezizæ comprise the genera *Pseudopeziza*, *Fabræa*, *Pyrenopeziza* (42 species including several new), *Pivottæa*, *Beloniella*, and *Velutaria*. The next suborder, the Heloticeæ, is divided into the sections Pezizelleæ, Cyathoidæ, Hymenoscyphæ, and Scleroticeæ. The Pezizelleæ comprise the genera *Pezizella* (61 species, several new), *Belonium*, *Gorgoniceps*, *Eriopeziza*, and *Arachnopeziza*. Of the Cyathoidæ, the present numbers include only the first genus *Phialea*.

Part 51 (Phycomycetes) commences with a general description of the Peronosporæ, made up of the genera *Pythium*, *Phytophthora*, *Cystopus*, *Basidiophora*, *Plasmopora*, *Sclerospora*, *Bremia*, and *Peronospora*. Of the genus *Pythium* 12 species are admitted, one new, of *Phytophthora* 2, of *Cystopus* 6, of *Basidiophora* 1, of *Plasmopora* 10, of *Sclerospora* 1, of *Bremia* 1. The illustrations are numerous and excellent.

Mycetozoa.

New Myxomycetes, causing Vine-diseases.¶—MM. P. Viala and C. Sauvageau have investigated the cause of a widely spread disease of the vine known in the South of France as *brunissure*, and find it due to an undescribed Myxomycete nearly allied to the *Plasmodiophora Brassicæ* of the cabbage, to which they give the name *Plasmodiophora Vitis*. It attacks the leaves only, in the form of brown spots on the upper surface, weakening the shoots and causing delay in the ripening of the fruit. The parasite develops chiefly in the palisade-cells,

* Journ. Cincinnati Soc. Nat. Hist., xv. (1892) pp. 39-52 (21 figs.).

† Bot. Centralbl., li. (1892) pp. 33-42.

‡ Bull. Soc. Mycol. France, vi. (1890) pp. 169-73 (1 pl.). See Bot. Centralbl., li. (1892) p. 105.

§ Zeitschr. f. Pflanzenkrankheiten, i. (1892) pp. 132-4. See Bot. Centralbl., 1892, Beih., p. 315.

¶ Comptes Rendus, cxiv. (1892) pp. 1558-60.

subsequently attacking the spongy parenchyme, but is very rarely found in the epiderm; the plasmode, when young, is very difficult to distinguish from the protoplasm of the cell. The formation of spores has not yet been observed.

The same authors also* trace a disease which is very destructive to the vineyards in California, and which is known to some growers under the name of "black measles," to the attacks of another species of *Plasmodiophora*, for which they propose the name *P. californica*. It causes an irregular discoloration of the leaves, and finally disease in the stem and roots.

Trichia.†—Herr A. Scherffel gives new diagnoses of the following species of *Trichia*, viz. *T. chryso sperma*, *affinis*, *scabra*, and *Jackii*, and points out the polymorphism that may occur within the same species, even in the microscopic structure. The form and dimensions of the tubes of the capillitium are more constant than their finer sculpture; while the finer sculpture of the spore-membrane is of great constancy. The best specific characters are, therefore, in the opinion of the writer, to be derived from the spores.

Lindbladia.‡—According to Mr. G. A. Rex, all the American forms of this genus of Myxomycetes belong to one species, *L. effusa*. He considers that although the two genera *Lindbladia* and *Tubulina*, which make up the order Liceaceæ, approach each other, having apparently been developed along similar lines, they nevertheless have probably arisen from independent, and, perhaps, widely separated points of origin.

Protophyta.

a. Schizophycææ.

Structure of the Phycochromaceæ.§—Herr G. Hieronymus has investigated the structure of the Phycochromaceæ, especially in relation to the nature of the peripheral colouring substance and of the central body; the genera specially examined were *Chroococcus*, *Glæocapsa*, *Aphanocapsa*, *Clathrocystis*, *Aphanothece*, *Hypheothrix*, *Oscillaria*, *Phormidium*, *Hydrocoleum*, *Symploca*, *Nostoc*, *Anabæna*, *Sphærozyga*, *Aphanizomenon*, *Rivularia*, *Scytonema*, *Tolypothrix*, *Hapalosiphon*, and *Stigonema*.

With reference to the green peripheral layer, the author comes to the conclusion that it is of the same nature as the chromatophore of the higher plants, though not identical with it. Fibrillæ and grana are both present, but do not form a connected whole. The layer consists of a comparatively small number of nearly parallel but rather distant fibrillæ, hence the pale colour, and this number may even be reduced to one. There is no true honeycomb-like structure, as described by Bütschli || in diatoms.

The central body of the Phycochromaceæ differs from the cell-nucleus of the higher plants in several important points. It is of much looser structure, is not entirely closed, and possesses no true nuclear

* Op. cit., cxv. (1892) pp. 67-9.

† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 212-8 (4 figs.).

‡ Bot. Gazette, xvii. (1892) pp. 201-5.

§ Beitr. z. Biol. d. Pflanzen (Cohn), v. (1892) pp. 471-95 (2 pls.).

|| Cf. this Journal, 1890, p. 497.

membrane. Instead of a complicated interwoven network, there is in it always a single nuclear filament only. Whether this central body is called a nucleus or not is a matter of comparative indifference; the author proposes to designate it an "open" nucleus, in contradistinction to the "closed" nucleus of higher organizations. Cell-division appears to be entirely independent of the condition of this central body.

Crystals of cyanophycin were found in several instances in the nuclear filament. The author gives, in great detail, the microchemical reactions of cyanophycin, and concludes that, although not identical with nuclein, chromatin, or pyrenin, it is a substance of the same nature, and that it corresponds to the granular constituents of the nucleus of higher plants. It also apparently serves as a reservoir for nitrogen; and this is no doubt connected with the symbiotic association of species of *Nostoc* and *Anabæna* with such plants as *Blasia*, *Anthoceros*, *Azolla*, *Cycas*, and *Gunnera*.

Herr E. Zacharias* criticizes on various points both these observations and those of Zukal.† He denies the accuracy of the term "nucleus" as applied to the central body of the Cyanophycææ, and maintains that we have no knowledge of the part which it plays in the economy of the cell.

Coccoïd Condition of a *Nostoc*.‡—M. C. Sauvageau describes a hitherto unknown mode of propagation in a *Nostoc*, probably *N. punctiforme*. The propagating cells resemble the spores or cysts, but continue to divide until they form amorphous colonies similar to those of *Aphanocapsa* and other Chroococcaceæ. The same individual may be made to pass alternately from the ordinary *Nostoc* to the coccoïd condition, and *vice versa*; this is the first example of such pleomorphism known among heterocystous algæ. In the coccoïd condition the cells are of a grey-brown colour; when about to pass into the *Nostoc* condition, a cell separates from the rest, develops the blue-green pigment, and forms a filament by repeated divisions.

M. P. Hariot§ identifies the so-called *Anabæna* found in the cells of *Cycas*, and the *Nostoc* in those of *Gunnera*, as chroococcoïd forms of *Nostoc punctiforme*, of which *N. Hederulæ* and *Polycoccus punctiformis* are synonyms.

Oscillariaceæ.||—M. M. Gomont publishes a Monograph of the Oscillariaceæ or Homocystous Nostocaceæ. The order is divided into two tribes—the Vaginarieæ, in which a number of trichomes are enclosed within a common sheath, and the Lyngbyeæ, in which, when a sheath exists, it encloses only a single trichome.

The Oscillariaceæ are distinguished by not having cells differentiated either into heterocysts or hairs, and by having no true branching. True spores have been found only in a single species. The cell is enclosed in a distinct membrane, which is never wanting, even in the homogones. It does not exhibit the reactions of cellulose, but rather those of fungin or cutin. Notwithstanding its tenuity, it is composed of distinct layers. The protoplasm of the cell is granular, and contains

* Bot. Ztg., l. (1892) pp. 617-24.

† Cf. this Journal, *ante*, p. 655.

‡ Comptes Rendus, cxv. (1892) pp. 322-5.

§ Tom. cit., p. 325.

|| Ann. Sci. Nat. (Bot.), xv. (1892) pp. 263-368 (9 pls.).

glycogen, but never starch; the granulations are of two kinds, coarser and finer. There are no chromatophores, and the presence of a nucleus has not been determined with certainty; in the normal state there are no vacuoles.

The apical cell of the trichome, when this latter is uninjured, is distinguished from the rest by being clothed, in its apical portion, with a thicker membrane, which constitutes an organ of protection. It is separated from the rest of the trichome by a thin wall, and ceases to divide. The author proposes to term this thick membrane the *calyptra*. The form of the calyptra is characteristic of each species; it is always intermediate between a cupola and a more or less sharp cone. The very delicate threads sometimes found attached to the apical cell are unquestionably parasites.

The sheath is either mucous or cartilaginous. Its chemical reactions are different from those of the cell-wall, and approach more nearly those of cellulose, but it is insoluble in the cupro-ammoniacal solution. The cells never divide in a direction parallel to the axis, and there is consequently no true branching; but a false branching is the rule in the Vaginarieæ and in *Plectonema*; it is terminal in the Vaginarieæ, lateral in the Lyngbyeæ.

The present paper is devoted to the Vaginarieæ, which are included under 6 genera, viz. *Schizothrix* (including *Inactis*, *Hypheothrix*, *Symplocastrum*, and *Chromosiphon*) (27 species), *Porphyrosiphon* (1 species), *Hydrocoleum* (10 species, chiefly marine), *Dasyglæa* (1 species), *Sirocoleum* (2 species), and *Microcoleus* (7 species). The following new species are described:—*Schizothrix rubella*, *S. mexicana*, *S. Lenormandeana*, *S. Beccarii*, *S. Lamyi*, *S. Braunii*, *Hydrocoleum coccineum*, *Microcoleus acutirostris*.

Formation of Ooliths.*—Examining the calcareous stones from the shore of the Great Salt Lake in Utah, Dr. A. Rothpletz found them to be covered with a blue-green coating consisting of colonies of *Glæocapsa* and *Glæothece*, which were excreting abundance of calcium carbonate. The lime is enclosed in the alga in roundish masses, and is a finely granular aggregate of calcite. These ooliths are undoubtedly the product of a lime-separating Schizophyte; and the author believes this to be the case with the greater number of the marine calcareous ooliths with a regular zoned and radial structure, as also with the vermiform calcareous structures of the Sinaitic Peninsula.

Rhizosoleniaceæ.†—Sig. H. Peragallo gives a monograph of this family of diatoms, comprising the genus *Rhizosolenia* and the allied genera *Dactyliosolen*, *Lauderia*, *Attheya*, and *Guinardia* gen. n. The family is divided into two sections, one with symmetrical, the other with unsymmetrical valves. To the former belong *Dactyliosolen* without spines but sometimes having a crown of marginal points, *Lauderia* with numerous more or less developed spines, and *Attheya* with two spines; the latter section comprises *Guinardia* in which the valves have an undulating border with a rudimentary lateral mucro,

* Bot. Centralbl., li. (1892) pp. 265-8.

† Le Diatomiste, i. (1892) pp. 79-82, 99-117 (5 pls.).

and *Rhizosolenia* in which the calyptriform valve has a more or less developed mucro generally terminated by a bristle.

A monograph of all the known species is appended. The new genus *Guinardia* is thus described:—Frustules cylindrical, ringed; valves circular with an undulation at the margin and a rudimentary mucro. The species of *Rhizosolenia* are further classified under three sections,—Annuulatæ with ringed frustules; and Squamosæ and Genuinæ in which the frustules are composed of more or less rhombic scales. In the former section the scales are very numerous; in the latter each section has not more than four, and generally only two. Many of the alleged species of *Rhizosolenia* belong to some other genus, or want an adequate description.

Entogonia.*—M. P. Bergon publishes a monograph of this rare genus of fossil diatoms. In describing the structure he terms the “central triangle” of Greville the central portion, the “broad border” the marginal portion, and the “pseudo-nodules” appendices. A full description is given of each of these parts. The existing definitions of the genus are somewhat modified, and the following is given as its diagnosis:—Valves usually triangular, rarely 2-, 4-, or 5-angular, containing an angular central portion rarely reduced to a simple straight line, and a marginal portion divided into compartments by false bands corresponding to internal septa; a more or less elevated appendix at each angle of the valve; subjacent canals uniting in pairs into a tube, which terminates in an orifice at a greater or less distance from the base of the appendices. The species are classified under two groups, Inornatæ (6 species) and Ornatæ (10 species). Three new species are described,—*E. Le Tourneuri* and *Temperei* belonging to the Inornatæ; and *E. Brunii* to the Ornatæ.

Lysigonium.†—Dr. J. B. Toni reviews the characters of Link's genus of diatoms *Lysigonium*, and proposes to limit it to three or four species, with the following generic diagnosis:—Frustula elliptica vel globosa, 2-3 ad articulos arcte conjuncta, non carinata, valvæ simpliciter punctatæ. The subgenus *Carinaria* is erected into a separate genus *Gallionella* Bory, with the characters,—Frustula globosa vel elliptica, catenata, carinata (superficie junctionis convexa nec plana), valvæ simpliciter punctatæ. The genus *Melosira* is limited to the species with the following characters,—Frustula cylindrica, arcte conjuncta, non carinata, subinde sulcis donata (superficie junctionis plana), valvæ simpliciter punctata. The following diagnosis is given of *Paralia*,—Frustula cylindrica, ut in *Melosira*, valvæ simul punctatæ et arcolatæ.

B. Schizomycetes.

Internal Structure of Bacteria.‡—Sigg. A. Trambusti and G. Galeotti record some observations they have made on the internal structure of a micro-organism, isolated from drinking-water, and cultivated on the usual nutrient media. Examination of the organism in hanging drops disclosed long bacillary and short ovoid forms, both of which

* *Le Diatomiste*, i. (1892) pp. 83-90, 128-47 (3 pls.).

† *Bull. Soc. Imp. Nat. Moscou*, 1891, pp. 71-5.

‡ *Centralbl. f. Bakteriol. u. Parasitenk.*, xi. (1892) pp. 717-22 (1 pl., 17 figs.).

exhibited slow movements. The protoplasm of the longer forms is homogeneous, and shows a few highly refracting puncta; but these have nothing in common with spores. Other bacillary forms are highly refracting throughout, and some not at all. The oval forms, most frequent in agar cultivations, are homogeneous, and always refracting.

The preparations were fixed with nitric acid after the method introduced by Sjöbring, and afterwards stained in various ways; but that which gave the most satisfactory results was a hydroalcoholic solution of safranin. The preparations were stained, without heat, in from 1-2 minutes. Cultivations in meat broth at 37° for 3-4 days were found to answer best, as in these the developmental stages could be easily followed out. During the first period the bacilli stain deeply and regularly throughout, and at this stage they may attain a length of 8-9 μ . Then the deeply stained portion is confined to long central areas, the external part being pale. After this is a stage where the body is pale, but studded along its sides with chromophilous granules. These granules next form oval rings, the granules being at first quite separate, but eventually becoming a series of darkly stained loops joined at their extremities, so that a moniliform appearance is produced. The rest of the organism is still pale pink. In the next stage the oval elements begin to separate from one another, and are finally set free. When free they lose their oval form and become cylindrical. The cylinders stain deeply throughout, and, in fact, are but the early condition of the first stage. Thus the cycle is formed.

The free oval forms are about 1.5 μ long and 0.9 broad, and while oval the periphery stains much more deeply than the centre. The authors do not consider these oval forms to be spores, as they have very slight resistance to heat, and they are not stained by methods used for spore-staining. They hold that these appearances are those of a real nuclear fission, having a remote resemblance to the mitosis of the higher cells.

Influence of Light on Bacteria.* -- Prof. H. Buchner has been making a series of experiments for the purpose of ascertaining to what extent the vitality of micro-organisms suspended in water is influenced by the direct action of sunlight. The organisms used for these experiments were typhoid bacilli, *B. coli communis*, *B. pyocyaneus*, cholera vibrio, and various putrefactive bacteria, which, in order to imitate the natural conditions as nearly as possible, were placed partly in sterilized and partly in non-sterilized water. The vessels in which the water was contained were of various sizes and shapes, and for each experiment the test was always double, that is to say, one vessel was open and exposed to the light, while the other was covered and protected from the influence of light by means of black paper. Some experiments were made indoors, but most in the open air; in all cases the temperature was recorded. The number of germs was estimated before and after the experiment by means of the gelatin plate method.

The experiments show conclusively that light exerted a powerful disinfecting influence upon the aforesaid bacteria when suspended in water. For example, water containing 100,000 germs of *B. coli*

* Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 781-3.
1892.

communis per ecm. at the outset of an experiment, was found to be quite free from them after one hour's exposure to direct sunlight.

The control test showed about the same number of bacteria at the beginning and at the end of the experiment. Diffuse daylight was found to exert a similar but less powerful influence.

From the foregoing the following conclusions are drawn :—(1) That in experiments as to the behaviour of bacteria in water, the influence of sunlight must always be reckoned with, hence most of the earlier observations can only be regarded as loosely approximate. (2) That though in the natural purification of rivers and lakes other factors may play a part, yet the influence of light must be regarded as the most important.

Effect of Ozone on Bacteria.*—Herr Ohlmüller has made some experiments with a view of testing the action of ozone on bacteria. In the first set, 478·8 mg. ozone mixed with 76 litres of dry air were made to pass over dry silk threads which had been previously steeped in a two days' old cultivation of typhoid bacillus. Not the least alteration was observed in the vitality of the micro-organisms after an exposure to the ozone of one hour. When, however, moist air was used, under similar conditions as in the previous experiment, no development of the bacilli took place.

A third experiment was undertaken with the object of ascertaining the action of ozone on bacteria adhering to objects in a large space, as in a dwelling room. The author came to the conclusion that ozone is not suitable for disinfecting either objects or dwelling rooms.

In the second portion of his work the author deals with the action of ozonized air on bacteria in watery fluids, and he found that ozone is strongly prejudicial to bacteria suspended in water, provided that the water is not too strongly impregnated with lifeless organic matter. The result is the same when the quantity of the organic matter is oxidized to a certain degree by the ozone.

Influence of Movement on the Growth and Virulence of Micro-organisms.†—Herr Schmidt has made some experiments for the purpose of ascertaining the effect of movement on bacteria. The movements were effected by means of a shaking apparatus, and partly by hand. A loopful of a pure cultivation was mixed with a certain amount of tap water or of distilled water, and after the shaking, roll cultivations were made from the fluid. The shaking apparatus appeared to exert an influence only on the Finkler-Prior bacillus, and once on anthrax, though the virulence of the latter was not diminished. Shaking by hand quite destroyed the vitality of *St. pyogenes citreus*, and diminished that of all bacteria suspended in tap water, but had not any perceptible effect on the bacillus of typhoid. The virulence of anthrax was not impaired. The author's view seems to be that the influence of the motion of water in the self-purification of streams has been much overrated, although he is inclined to think that the pressure from a mass of water might kill single microbes or diminish their virulence.

* Arb. K. Gesundheitsamte, viii. (1892) No. 1. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 773-5.

† Arch. f. Hygiene, xiii. p. 247. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 691-2.

Bacteriology of Water.*—Prof. P. F. Frankland and Marshall Ward have presented their first report to a Committee of the Royal Society on the present state of our knowledge concerning the bacteriology of water, with especial reference to the vitality of pathogenic Schizomycetes in water.

They point out that the first fact to be firmly grasped is that water, as met with in actual life, is a very variable medium indeed; it is probable, indeed, that no two samples of distilled water are absolutely alike in constitution, when the water distilled has been taken from different sources. The second fact of importance is that a Schizomycete is not only a very minute organism, but that it requires correspondingly minute traces of food material for its nutrition. Another, though less obvious, truth is that a Schizomycete is an extremely delicate organism, and it is a variable factor in itself, because it has a variable organization.

Water affects a living speck of protoplasm put into it, not only mechanically, but more especially physically and chemically; the gases dissolved in the water exert pronounced effects; any dissolved or suspended substances in the water must exert definite actions on the living organism; the temperature of the water is of the utmost importance for the life or otherwise of any given species; in some cases, at any rate, certain rays of light may complicate matters when they fall in sufficient quantity on water containing bacteria in suspension, or organic matters in solution.

Distilled or pure water, as it is unknown in nature, offers little scope for practical enquiry, but may be used in check experiments. With sterilized water it is very different, for most observers agree as to the longer vitality of pathogenic forms in sterilized water than in the same water before sterilization. But whether water be sterilized by heat or by filtration, its constitution may be altered, but the latter method is certainly preferable to the former. With regard to the results of various observers, it is thought the numerical results obtained by the gelatin-plate method are, on the average, too low; several workers have employed temperatures which are too high for comparison with what occurs in natural waters in this country; many results have been vitiated by the introduction of very concentrated food materials with the pathogenic germs employed for infection. Conclusions drawn from experiments with distilled water must be received with great caution; and in considering those from cultures in sterile waters, due regard must be had to all the facts, especially if the water was sterilized by heat. Neither mineral nor snow or rain water must be regarded as free from pathogenic germs capable of living; in fact *any* water whatever may convey living pathogenic germs from one place to another.

In all ordinary waters the rule is that the pathogenic forms die out sooner or later, with or without temporary multiplication. This final result is very commonly reached in three stages:—there is a preliminary diminution, due to the death of large numbers occasioned by the shocks induced by their altered environment; there is a larger or shorter period of more or less active growth and multiplication; and gradual diminution in numbers and vigour, as the available food-materials become exhausted.

* Proc. Roy. Soc. Lond., li. (1892) pp. 183-279.

With regard to specific forms of pathogenic bacteria:—

(i.) *Spirillum cholerae asiaticæ*. Very conflicting statements are given as to the length of time in which it lives in water, but all agree that it can be conveyed by water, and is not, as a rule, very resistant towards competing forms.

(ii.) *Bacillus typhosus* seems, in most cases, to be much more resistant than the cholera-spirillum.

(iii.) *Bacillus anthracis* forms spores which may live in sterilized water for months without injury, if the temperature be not too high.

(iv.) *Streptococcus erysipelatis* is very susceptible to immersion in water.

(v.) *Bacillus tuberculosis* has been found to live for more than 115 days in distilled water, and 95 in river water.

Bacteriological Examination of Air in Freiburg.*—Herr Welz has made a systematic examination of the air in and about Freiburg for the purpose of ascertaining the number and variety of the Schizomycetes which might occur under different conditions. The researches were prolonged over a whole year, and carried out under various weather conditions. The air was taken from four different situations:—(1) the garden of the Botanic Institute; (2) a room in a dwelling-house in the middle of the town; (3) a ward of a hospital; (4) a mountain 738 m. high, about two leagues distant from the town.

The method adopted simply consisted in sucking the air into flasks filled with sterile fluid. After the aspiration was finished, 1 ccm. of the fluid was mixed with 10 ccm. of nutrient gelatin. Observations were made on the plates for 14 days to 3 weeks, and it was found that aerial Schizomycetes grew far more slowly even under favourable conditions than those taken from water or the soil. In each experiment 10 litres of air were used. On the whole it was found that in warm weather the Schizomycetes were more numerous than in cold or rainy weather. Fogs appeared to exert a notable influence on the multiplication of bacteria, for except in cold November fogs they were much increased.

In the middle of August yeast fungi began to appear, attaining their maximum in October. Later on, and in rainy times, mould fungi were predominant.

The air taken from the mountain showed no quantitative or qualitative differences as to Schizomycetes, although it had considerably less mould fungi than the town air.

No important difference could be detected between the air taken from open places and that from close human dwellings, provided the latter were in good sanitary condition. On the other hand, when the latter places were in unhygienic conditions, the Schizomycetes increased, and the appearance of pathogenic fungi (*St. pyogenes aureus*) was observed. In open places near a large town these conditions seemed to have some influence on the air, while in that taken from the mountain the quantity of Schizomycetes was less, and their distribution more equal.

The author ends by giving a list of bacteria found, but it is too long to quote *in extenso*.

* Zeitschr. f. Hygiene, xi. p. 121. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 630-2.

Immunity Question.*—Prof. E. Klein has made a series of experiments to demonstrate that bacteria when injected into frogs are not destroyed at the inoculation site. Virulent anthrax bacilli or anthrax obtained from guinea-pigs dead of the disease were placed in sterile salt solution, and about 0·25 cm. was injected into the dorsal lymph-sac. After various lengths of time, 10 minutes, 30 minutes, 60 minutes, 2 hours, 24 hours, the animals were killed and cultivations made direct from the beasts' blood and also from the spleen. The gelatin tubes were incubated at 20°, and the agar tubes at 37° for 48 hours.

These experiments showed that the microbes were very rapidly absorbed into the blood stream, and that their eventual destruction is certainly not confined to the inoculation site. Besides this the same experiments proved that, while the micro-organisms could be demonstrated with facility and in large numbers at 10, 30, and 60 minutes after injection, their number was considerably reduced after two hours. And as no leucocytosis was observed at the lymph-sacs, it seems probable that the diminution in numbers was not due to the interference either of the white cells of the blood or those of the spleen.

In two other series *Bacillus prodigiosus* and *Staphylococcus py. aureus* were injected under similar conditions. In both series there was rapid absorption of the microbes, but in both the antagonism to the bactericidal influence was more marked even than in the case of anthrax.

Action of Tobacco on some Pathogenic Microbes.†—Dr. V. Tassinari finds that tobacco smoke has a very well marked bactericidal power, and specially on the bacillus of cholera; he thinks that when it or typhus is epidemic, the use of tobacco may be of some advantage. For the hygiene of the mouth tobacco may be seriously considered as a prophylactic agent against affections of the buccal cavity which are of parasitic origin.

Bacteria of Raw Meat.‡—The experiments of Kraus on raw butcher's meat (beef, mutton, veal, pork), were made to ascertain the kind and number of bacteria present therein. The meat used was that of animals slaughtered 24 hours previously; and from this for a period of 2–3 weeks plate cultivations were made daily. The author came to the conclusion that the bacteria found were common to all kinds of flesh, and that no particular sort of meat was specially affected by one or more kinds of bacterium.

The bacteria present in raw meat may be very numerous, and the number is certainly augmented in hot dry weather, and of course varies with the time of the year. It was found that when mice were infected with the juice of decomposed meat, the same bacillus was always found in the animal after death. This bacillus appeared to be identical with *Bac. enteriditis* (Gaertner) and the notion that this bacillus may become pathogenic owing to the presence of Saprophytes has some justification.

* Centralbl. f. Bakteriöl. u. Parasitenk., xi. (1892) pp. 598–602.

† Ann. Ist. d'Igiene Sperim. Univ. Roma, i. p. 155. See Ann. de Micrographie, iv. (1892) pp. 518–9.

‡ Friedrich's Blätter f. gerichtliche Medizin u. Sanitätspolizei, 1890, p. 343. See Centralbl. f. Bakteriöl. u. Parasitenk., xi. (1892) pp. 602–3.

Bacillus of Grouse Disease.*—Dr. E. Klein, who has for some years been engaged in investigating the cause of grouse disease, attributes it to a bacillus belonging to the same group as those which cause fowl and duck cholera, swine fever, and American hog cholera, &c. All these bacilli are oval in shape, and generally arranged in dumb-bells; they are aerobic, do not liquefy gelatin, but exhibit considerable and definite differences as regards rapidity of growth.

Chemico-bacteriological Examination of Sausages.†—Sig. Serafini has made a chemical and bacteriological examination of twenty-one sausages of different age and make. In twenty cases he found a liquefying bacillus greatly resembling that isolated by Nauwerck from a case of sausage poisoning. After a careful examination it was identified as *B. mesentericus vulgatus* Flügge, and it is suggested that this organism came from the sausage-skin rather than from the sausage-meat, since the author was able to isolate this bacillus from the large intestine of pigs by means of plate cultivations.

It was found that, both in sausages intended to be eaten fresh and in those intended to be kept for a time, various species of bacteria were present in considerable numbers. It would therefore seem that in meat sausages which can be kept for a considerable time the bacteria must exist in the spore-form or in a latent condition, so that for the preservation of sausage-meats the object to be obtained is to promote those conditions which will prevent the further development of micro-organisms.

The conservation of sausage-meat chiefly depends on the drying of the meat, and the presence of cooking salt contributes to this, as it prevents the rapid development of bacteria, and thus allows the meat time to dry before it has become spoilt. For each kilogram of meat 50 grm. of cooking salt is sufficient. It is not necessary to push the drying to its extreme limits; it is only necessary to continue it till there is 35–40 per cent. of water.

From what was previously said, it is obvious that the sausage-skins should be carefully cleansed and disinfected.

Diffusion of Tetanus Spores through Air.‡—Herr R. Schwarz has made some experiments to ascertain if tetanus spores could be diffused through the air, and hence to explain the appearance of this disease in surgical wards of hospitals. It was necessary to find out if the spores could be disseminated through the air along with the dust, to what height they could be carried, and whether they would deposit on the floors and walls of the infected places.

For this purpose 150 ccm. of dust, an equal bulk of water, and 20 ccm. of impure gelatin cultivation of tetanus bacilli, were mixed together and allowed to dry. The material thus obtained was powdered and strewn about on the floor of a small place selected for the purpose. Hot pans filled with sterilized gelatin were then placed in the room at

* 'The Etiology and Pathology of Grouse Disease, Fowl Enteritis, and some other diseases affecting Birds,' London, 1892, 8vo, xii. and 142 pp. (53 figs.).

† Arch. f. Hygiene, xiii. p. 173. See Centralbl. f. Bakteriologie u. Parasitenk., xi. (1892) p. 766.

‡ Arch. per le Scienze Med., xv. No. 19. See Centralbl. f. Bakteriologie u. Parasitenk., xi. (1892) pp. 697–8.

various heights (up to 1.65 m.), and the dust on the floor blown about. The dust-covered gelatin was then liquefied and poured into sterilized tubes. In 3-4 days the presence of tetanus bacilli was manifested. The injection of a few drops of this cultivation produced acute tetanus in two rabbits.

After the diffusion of the spores through the air had thus been proved, several rabbits were introduced into the same place. The backs of these rabbits were cut in places so that deep wounds 14-16 cm. square in size were made. The dust on the floor was then stirred up. Several of the rabbits died of typical tetanus.

These experiments are intended to prove that tetanus spores are deposited not only on floors, but on the walls of rooms; and hence, when tetanus breaks out in surgical sick rooms, it is necessary that not only the floors, but also the walls should be carefully disinfected.

Earthworms and the Bacilli of Tubercle.*—MM. Lortet and Despeignes have found that if earthworms take up tubercle bacilli, they will remain for months in an infectious condition, and it is therefore concluded that these animals play a part in the ætiology of tuberculosis.

The authors claim to be the first to have shown that it is possible to infect an invertebrate animal with tuberculosis.

Morphological and Cultivation Characters of the Influenza Bacillus.†—Sig. A. Bruschetti records the following morphological and cultural characters of this microbe. On oblique agar it develops in small dewdrop-like colonies, which may become confluent so as to form a complete overlay.

In stroke cultivations on agar plates small flat yellowish colonies develop in 4-5 days at 37°. On gelatin-, pepton-, and glycerin-blood-serum there are formed numerous colonies; but these are less transparent than those on agar. In serum puncture cultivations development takes place only along the puncture, and the colonies are largest and most numerous at the deepest part of the puncture. In rabbit's blood the growth was excellent, both with and without air. In bouillon the bacillus only grew in the absence of air, and in gelatin-puncture cultures only a few colonies developed when air was admitted, while when air was excluded the growth was copious.

On gelatin plates small round yellowish colonies appear in about six days. As these grow older they become brownish, their edges uneven, and their surface rough. On agar the influenza bacillus usually resembles an elongated Fraenkel's diplococcus; in rabbit's blood or on serum the shape is a well-marked rodlet, which may form short chains.

In gelatin both forms are commingled, while in bouillon the diplococci predominate. Some involution forms were observed; these were only stainable at the ends, and at times one end was expanded.

The bacillus is motionless, and stains well with Loeffler's methylene-blue (used warm) and dilute Ziehl's solution.

* La Semaine Méd., 1892, No. 5. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xii. (1892) p. 36.

† La Riforma Med., 1892, No. 66. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xii. (1892) pp. 34-5.

Influenza Bacillus.*—Drs. Pfeiffer and Beck, who have been making further investigations on influenza germs, have not been able to detect influenza bacilli in the blood, and declare that the bacilli bred by Canon from blood of influenza patients are not identical with the bacilli described by them. The latter are found as a rule and exclusively in broncho-pneumonia foci and on the bronchial secretion of influenza patients. To find the bacilli in the sputum the greenish-yellow viscid particles must be examined. Cover-glass preparations and celloidin sections of broncho-pneumonia portions of lung were stained in Ziehl's solution (10–20 times diluted) for 10–30 minutes; they were then carefully decolorized in absolute alcohol and cleared up in xylol. The bacilli, somewhat shorter and slenderer than those of mouse septicæmia, were found both within the cells of the cover-glass and in section preparations, and also free.

The authors failed to cultivate the influenza bacilli on glycerin-agar, and the only successful medium was made by rubbing a drop of healthy human blood on agar. The inoculation material was obtained from flakes of bronchial secretion carefully removed from the sputum. After a microscopical examination had demonstrated the absence of foreign micro-organisms, the flakes were rubbed up with 1 ccm. of sterile water. The cultivations reached their maximum in the incubator in about 48 hours, after which they soon died. The colonies were very minute and resembled little drops of water.

Apes when inoculated with this bacillus underwent a febrile condition lasting some days, but all other animals were immune.

The bacilli quickly die when dried, when heated up to 60°, and from the action of chloroform. They are found in influenza sputum for some days after the febrile stage of the disease has passed off, but then lie chiefly within the cells, stain badly and cannot be cultivated.

Bacteriology and Butter-making.†—Herr H. Weigmann has some notes on this subject. Butter which comes into the open market is of two sorts, the sweet and the sour; the latter owes its characteristic flavour and aroma to fermentation products, the result of the lactic fermentation taking place in the cream.

Now the number of bacteria in air, water, &c., capable of setting up the lactic fermentation is not small, and many of these impart disagreeable flavours and odours to butter; indeed the proper consistence may be impaired or lost.

As cream is not suitable for pasteurization, the obvious method, instituted by the author and now carried out in many dairies with great success, was to acidify the cream with a pure cultivation of a lactic acid bacterium of known properties and approved action. In practice the new method consists in keeping some centrifuged or skim milk (about 2–3 per cent. of the bulk of cream to be made into butter) for 3–4 hours at a low temperature. It is next heated to 25°, and then inoculated with the bacteria cultivation. The inoculated milk is then placed in a warm room until the acid is ready for use.

* Deutsche Med. Wochenschr., 1892, No. 21. See Centralbl. f. Bakteriologie u. Parasitenkunde, xii. (1892) pp. 33–4.

† Milch-Zeitung, 1890, p. 945. Landw. Wochenbl. f. Schleswig-Holstein, 1892, No. 16. See Centralbl. f. Bakteriologie u. Parasitenkunde, xi. (1892) pp. 762–4.

Cream prepared after this manner and mixed with the acid is ready for butter-making in about 24 hours.

Bacteroids of the Leguminosæ.*—From experiments made by Herr D. Morck on 64 species of Leguminosæ (49 Papilionaceæ, 8 Cæsalpinieæ, and 7 Mimoseæ), he has come to the conclusion that tubercles may appear on the roots of all leguminous plants under favourable conditions. He states that in the youngest cells of the tubercles no bacteroids are to be seen, but only a protoplasmic substance and numerous small globular microbes. These increase greatly in number and size at the expense of the protoplasmic substance, and assume the form of rods, which often branch. When they have attained a certain size, they begin to be resorbed for the benefit of the plant. When the bacteroids have entirely disappeared there remain in the cells only some small microbes, which return to the soil.

American Rhizobia.†—Mr. A. Schneider has investigated the symbiotic fungus in the roots of a number of American Leguminosæ, and has come to the conclusion that there are probably several distinct species of *Rhizobium*, for which he proposes the names *R. mutabile*, symbiotic on *Trifolium pratense*, *T. repens*, *Melilotus alba*, and *Lathyrus odoratus*, *R. curvum* on *Phaseolus pauciflorus*, *R. Frankii* on *Phaseolus vulgaris* and *Pisum sativum*, *R. nodosum* on *Dalea alopecuroides*, *Robinia Pseudacacia*, and *Cassia Chamæcrista*, and *R. dubium* on *Amphicarpæa comosa*.

Bacillus of the Sugar-cane.‡—M. T. Valetton confirms Jansé's observation of the presence of *Bacillus Sacchari* in the cultivated sugar-cane; he finds it also in three wild varieties, and in the rice-plant. It was accompanied by *Bacillus Glagæ*.

Bacillus pyogenes fœtidus.§—Signor E. Burci describes the microscopic characters of a bacillus isolated from an abscess, and its behaviour on nutritive media. This microbe, *B. pyogenes fœtidus*, is a facultative anaerobe thriving in an atmosphere of carbonic acid or of sulphuretted hydrogen.

Inoculation with small quantities produced abscesses in animals, and in the pus of the abscesses the same bacillus was always found. If large quantities were injected then general disorder ensued and terminated in death.

If the cultivations were kept at 37° for several days, the pathogenic properties of the bacillus were usually diminished; though this was not always the case, as two animals died some days after inoculation, and the bacillus was found in both. If the metabolic products of the bacillus were injected, only those animals died which had received the largest doses (10 ccm.). In these cases the post-mortem examination was negative. Animals when injected with small quantities were found to remain immune to the bacillus for thirty-four days.

* Ueb. d. Formen d. Bakteroiden b. d. einzelnen Sp. d. Leguminosen, Leipzig, 1891 (5 pls.). See Bot. Centralbl., li. (1892) p. 119.

† Bull. Torrey Bot. Club, xix. (1892) pp. 203-18 (2 pls.)

‡ 'Bacteriolog. onderzoek v. riet-varieteiten,' Soerabaia, 1891. See Bot. Centralbl., xl. (1892) p. 177.

§ See Centralbl. f. Bakteriolog. u. Parasitenk., xi. (1892) pp. 666-7.

Cultivations in carbonic dioxide and sulphuretted hydrogen did not appear to diminish the virulence of the micro-organism, at any rate to any great degree. Acid reaction of the medium does not prevent the growth and development of the bacterium, even when 2·5 per thousand lactic acid was present, nor are its pathogenic properties diminished by this reaction.

Streptothrix Cuniculi.*—Herr Schmorl relates that at the pathological institute of Leipzig an epidemic broke out, causing the death of twenty-eight rabbits which were kept together. The cause of death was a micro-organism found in all the organs, and usually as a pure cultivation. The malady was marked by necrosis beginning on the lip and rapidly spreading to the subcutaneous tissues, by fibrinous inflammation of the serous membranes (pleura, pericardium, peritoneum), and also by inflammatory changes in the lungs. In these places a thread-like bacterium belonging either to *Leptothrix* or *Cladothrix* was present.

Pure cultivations in blood-serum showed that it was an obligatory anaerobe. Inoculation experiments on rabbits with the pure cultivations reproduced exactly the same disease phenomena and the same micro-organism. Besides rabbits only white mice were susceptible, guinea-pigs, dogs, cats, pigeons, and fowls being refractory.

In man and guinea-pigs the micro-organism would only thrive provided that suppuration bacteria have already created a suitable cultivation soil. Hence it may be assumed that *Cladothrix Cuniculi* is non-pathogenic to man and guinea-pigs.

Streptococcus conglomeratus.†—Herr Kurth gives a long description of a coccus which he has isolated from a considerable percentage of scarlet fever cases, *Streptococcus conglomeratus*.

Though the author's work is chiefly occupied with this microbe, it also deals with streptococci generally, and with those found in scarlet fever more particularly, the object of the investigation being to find diagnostic characters for discriminating the various species. By cultivation in bouillon streptococci were found to grow in three different ways, and to give rise to different forms of deposit, and these deposits also corresponded with different appearances in the microscopical preparations. Cultivations in gelatin were found to afford a diagnostic criterion as regards the minimum temperature, most streptococci at 16°–17° giving visible evidence of growth in 2–3 days, while *St. conglomeratus* did not show any development till the sixth day at least. *St. conglomeratus* is fatal to mice, though the length of time it takes to kill is very variable. The length of time during which different species of streptococci remain viable in bouillon varies much, some lasting for months, while others, among which is *St. conglomeratus*, are not inoculable after 10–20 days.

Streptococcus conglomeratus is recognized as being a distinct species possessing a strongly pathogenic action, but beyond the suspicious frequency with which it has been found in scarlet fever cases, a causative connection between this microbe and the disease has not been made out.

* Deutsche Zeitschrift f. Thiermedizin, 1891. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) p. 666.

† Arb. K. Gesundheitsamte in Berlin, vii. (1891) p. 389.

Identity of *Streptococcus pyogenes* and *Streptococcus erysipelatis*.*—Dr. M. Kirchner records the case of a young soldier who was admitted to a military hospital for phthisis. After a period of about two months, during which he was injected with tuberculin, he was seized with a rigor. The tonsils swelled and became covered with white membrane. A microscopical examination failed to detect the bacilli of diphtheria, but disclosed the presence of *Streptococcus pyogenes*. Three days after he was attacked with well-marked facial erysipelas, in the bladders of which well-developed chain cocci were found. The case shows either that *St. pyogenes* caused the suppurative tonsillitis, and *St. erysipelatis* the erysipelas, and that the patient was suffering from two acute specific diseases at the same time, or that the same micro-organism was the cause both of the tonsillitis and of the inflammation of the skin. The cocci of course are apparently of the same size, and have the same staining reactions.

Inoculation Experiments with Giard's Pathogenic Light-bacillus.†—Mr. H. L. Russell injected two large specimens of *Palæmon serratus* with a 24 hours old sea-water bouillon cultivation of Giard's light-bacillus. The inoculations were made between the first and second abdominal segments, and underneath the chitinous plate covering the sterna. Two other specimens were wounded in a similar way but not injected. No light was observable on the seventh day after injection, but when either of the injected animals was taken up in the hand, a pale phosphorescent light illuminated it all over. This phenomenon, which did not occur in the uninjected animals, was observed for about three weeks. Microscopical examination and plate cultivations made from the tissues of the injected animals failed to reveal anything, and the author thinks that the illumination is in some way or other connected with muscular movements or contractions. In any case the experiment showed that the illumination phenomenon was not of a pathogenic nature.

Alexin of the Rat.‡—Mr. E. H. Hankin finds that the discrepancy between his results and those of Metschnikoff as to the immunity conferred by the alexin of the rat is explained by the difference in the age of the anthrax cultivations used for mixing with the serum. By using a six months old agar cultivation, the same results as those obtained by the French observers ensued. The animals all died, although there was some postponement of the event. When fresh spores are used under similar circumstances, these results are as a rule reversed. Sometimes however, even when fresh spores are used, the animals died simultaneously with the control animals, or only a little later. For this aberration the author suggests some unusual condition of the serum, but he does not pretend to explain the difference between the action of the spores of old and young cultivations.

The next step leads to the behaviour of the phagocyte. The author had concluded that the inhibitory action of rat's serum was due to its germicidal properties, but Roux and Metschnikoff had found that the majority of the spores were contained within phagocytes. Hence it is assumed that the serum of the rat exerts a strong chemotactic action on

* Centrabl. f. Bakteriöl. u. Parasitenk., xi. (1892) pp. 749-52.

† Tom. cit., pp. 557-9.

‡ Tom. cit., pp. 722-7.

the phagocytes of the mouse. By aid of their protection the mouse remains healthy until some phagocyte happens to perish, when the spores become free and the disease is at once set up.

Before this view could be accepted it was necessary to find whether other kinds of serum having no inhibitory action exerted a less chemotactic action on the mouse phagocyte. For this purpose the serum of quite young rats was used, and it was found that there was absolutely no difference between the chemotactic activity of the young and old rat serum, although that of the former contains almost no alexin. Hence it would seem that the chemotactic activity of the serum of the adult rat is not the principal cause of its power of inhibiting the development of anthrax spores in mice, and the experiments go to show that the action of the phagocytes depends on the presence of alexins.

Lupulin and *Micrococcus Humuli Launensis*.*—Herr A. Mohl finds that normal lupulin grains always contain an innumerable quantity of micrococci, *M. Humuli Launensis*, while other organisms, (bacteria, &c.) have not been detected. In the oil and resin cells the micrococcus is either absent or very infrequent.

***Bacillus typhi murium* and the Mouse Plague.**†—Prof. F. Loeffler narrates his experiences in Thessaly whither he had been summoned by the Greek Government to put down the plague of field mice with which that part of Greece has been devastated. The author recounts at some length his adventures and the successful issue of the experiments, which had hitherto not been tried on a large scale, although the fact that field mice were killed after eating fodder soaked with cultivations of *Bacillus typhi murium* had been known since the publication of the author's original paper some eighteen months ago. In that communication ‡ it was further shown that this bacillus was pathogenic only to field and house mice, all other animals being quite unaffected by it, and it was then suggested that this micro-organism might be used for combating the extraordinary hordes of field mice which sometimes occur in certain countries. On arriving in Greece the author found that the Thessalian field mice differed in many respects from *Arvicola arvalis*, the French Campagnol; it was larger, of a lighter colour, with large bright eyes and an unusually short tail. Its track marks were much more distinct than those of the German field mouse. It was necessary, therefore, to ascertain if *B. typhi murium* were pathogenic to this particular field mouse. This question was soon settled in the affirmative, for the injected mice died in from 2-4 days, and the fed mice in from 5½-7 days, and the morbid appearances were identical with those of mouse typhus. The author then describes how cultivations of the micro-organisms were made on a large scale; the medium was oat or barley straw decoction to which 1 per cent. pepton and 1/2 per cent. grape sugar had been added. The decoction was neutralized with soda, and having been placed in large vessels each holding 60 litres, was steam sterilized. In case of accidents some 400 agar tube

* Oesterr. Landw. Centralbl., 1892. See Centralbl. f. Bakteriologie u. Parasitenk., xii. (1892) p. 32.

† Centralbl. f. Bakteriologie u. Parasitenk., xii. (1892) pp. 1-17.

‡ Cf. *ante*, p. 280.

cultivations were also made; each of these tubes was sufficient to impregnate a litre of water in which bread could be soaked.

The method adopted was merely to soak bread in the infected cultivation fluid and place a small piece in the holes, and the way the treatment worked itself out was by the mice handing the disease on from one to another, the dead bodies being eaten by their comrades and so on. In a few weeks the numbers of the field mice were so much reduced that it was admitted by everybody that the plague was stayed.

Bergonzini's "Micrococci."*—Sig. C. Bergonzini attempts in this monograph a scientific classification of Bacteria and more especially of Micrococci. The usual signification of the terms Staphylococci, Streptococci, &c., is discarded, and the grouping of Micrococci is employed as a basis for classifying four subgenera with the following characters:—(1) Micrococci occurring singly or in irregular masses (Staphylococci). (2) Micrococci usually arranged in pairs (Diplococci). (3) Micrococci usually forming chains (Streptococci). (4) Micrococci usually arranged in tetrads (Sarcina, Merismopedia). These are further subdivided according to their behaviour in artificial nutrient media.

The author does not take mobility into consideration, as he describes cocci as being always motionless or with only a faintly discernible oscillation. The different arrangement of the material is little distinguishable from that of most diagnostic handbooks and tables.

Baumgarten's Annual of Pathogenic Micro-organisms.†—The sixth volume of this useful and comprehensive report on pathogenic micro-organisms, including Bacteria, Fungi, and Protozoa, has recently appeared. The present volume maintains the high character of its predecessors and is on quite similar lines.

ABBOT, A. C.—*The Principles of Bacteriology.* London, 1892, 8vo.

Beiträge zur Physiologie u. Morphologie niederer Organismen. Aus dem kryptogam. Laboratorium der Universität Halle a. S. Hrsg. v. W. ZOPF. (On the Physiology and Morphology of Lower Organisms. From the Cryptogamic Laboratory of the University of Halle a/S. Edited by W. Zopf.)

Part 1, Berlin, 1892, large 8vo, vi. and 97 pp. (3 figs.)

BOUCHARD, CH.—*Les microbes pathogènes.* (Pathogenic Microbes.)

Paris, 1892, 16mo.

FRAENKEL, C., U. R. PFEIFFER—*Mikrophotographischer Atlas der Bakterienkunde.* (Microphotographic Atlas of Bacteriology.)

Parts 14 and 15 (conclusion), Berlin, 1892, large 8vo, xii. pp., with 8 photo-plates and 8 sheets of explanation.

GLEYS ET CHARRIN—*Les habitats des microbes.* (The Habitats of Microbes.)

Compt. Rend. Soc. Biol., 1892, pp. 553-5.

HOOD, P. H.—*An Inquiry into Malaria or Marsh Miasmata and the so-called Malarial Fevers.*

Pacif. Med. Journ., 1892, pp. 141-56, 202-12, 271-96.

KAMEN, L.—*Ueber den Erreger der Malaria.* (On the Cause of Malaria.)

Beitr. z. Pathol. Anat., 1892, pp. 395-406.

* Modena, 1890, folio, 67 pp. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xi. (1892) p. 692.

† P. Baumgarten, 'Jahresbericht über die Fortschritte in der Lehre von den pathogenen Mikroorganismen, umfassend Bakterien, Pilze und Protozoen, unter Mitwirkung von Fachgenossen bearbeitet,' vi. (1890) erste Hälfte, pp. 352, Braunschweig, 1891. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xi. (1892) p. 730.

- LASER, K.—Bericht über die bakteriologische Untersuchung des Königsberger Wasserleitungswassers in der Zeit vom Dez. 1890 bis Dez. 1891. (Report on the Bacteriological Examination of the Water Supply of Königsberg from December 1890 to December 1891.) *Centralbl. f. Allg. Gesundheitspf.*, 1892, pp. 133-45.
- SCHULZ, L.—Ueber den Schmutzgehalt der Würzburger Marktmilch und die Herkunft der Milchbakterien. (On the Dirt of the Milk Market of Würzburg, and the Origin of the Bacteria of Milk.) *Arch. f. Hygiene*, XIV. (1892) pp. 260-71.
- THÜMEN, N. v.—Die Bakterien, ihre Bedeutung im Haushalte des Menschen und der Natur. (Bacteria and their importance in the Economy of Man and Nature.) *Prometheus*, 1892, pp. 449-73.
- TRAMBUSTI, A.—Ueber die Frage der Identität des Bacillus von Eberth mit dem Bacillus coli communis. (On the Identity of the Bacillus of Eberth with the *B. coli communis*.) *Centralbl. f. Allg. Pathol. u. Anat.*, 1892, pp. 321-8.



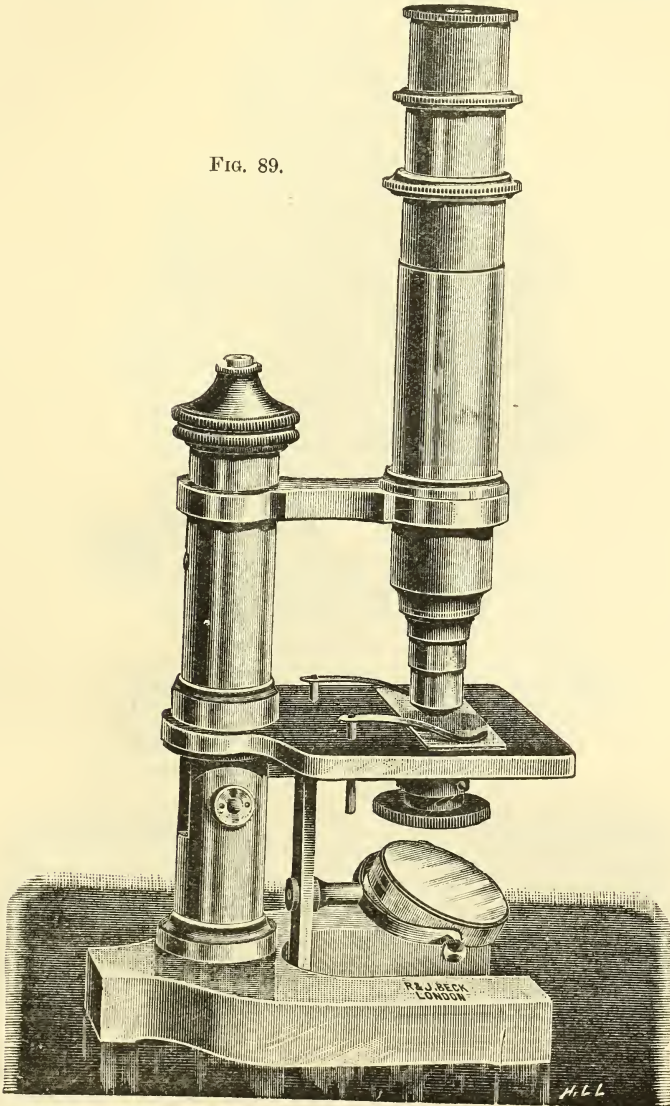
MICROSCOPY.

a. Instruments, Accessories, &c.*

(1.) Stands.

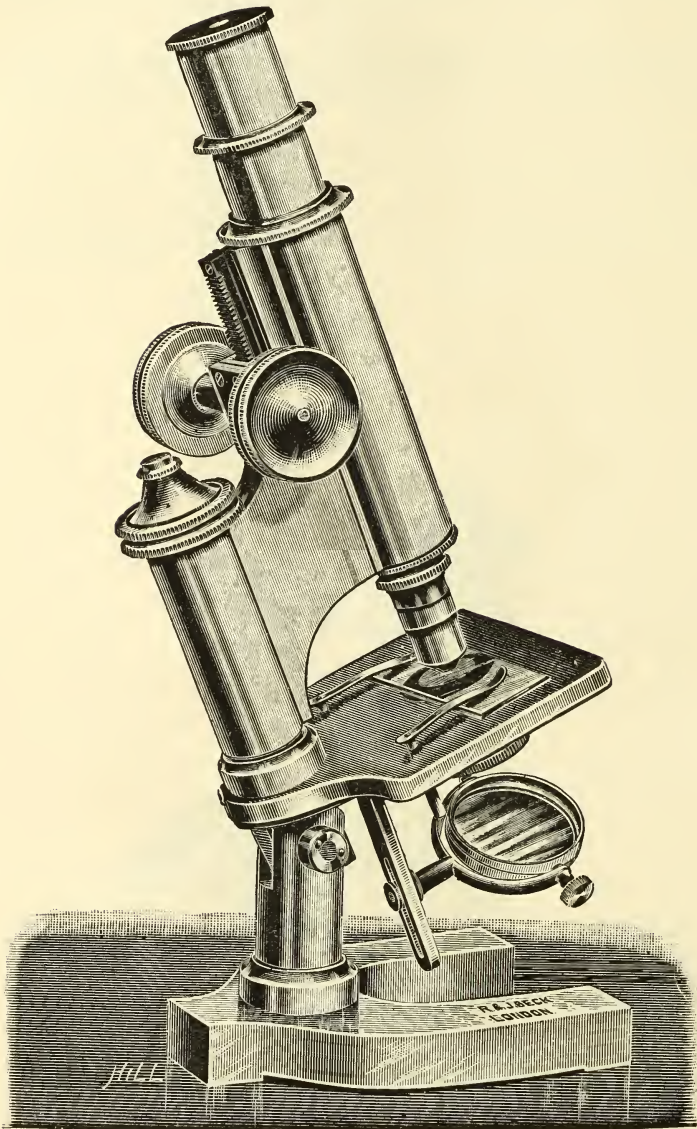
Beck's Improved "Continental" Model Microscopes.*—This is a new and very solid and substantial model Microscope designed by

FIG. 89.



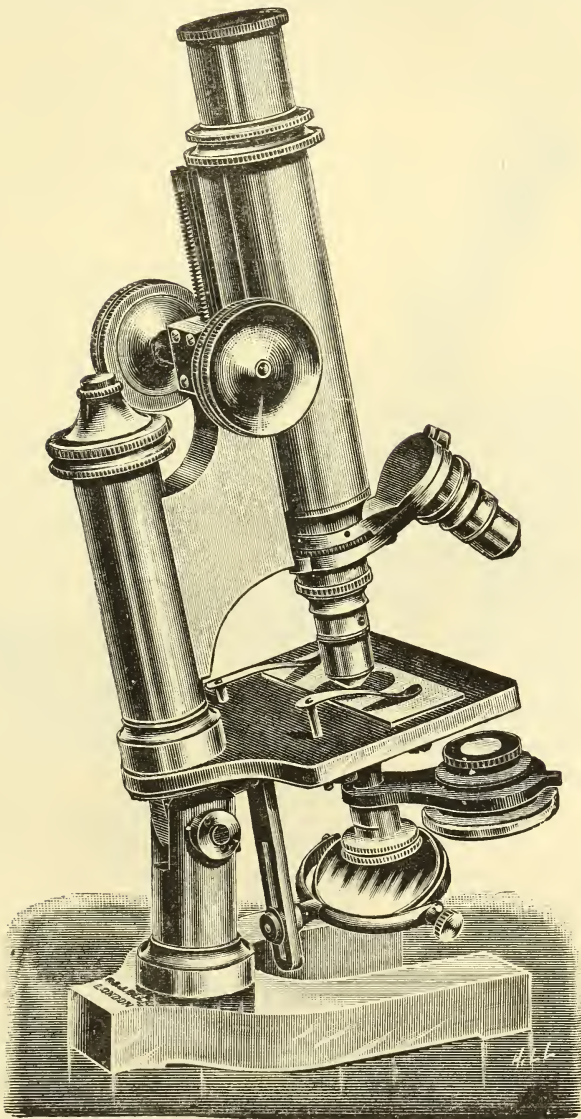
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

FIG. 90.



Messrs. R. and J. Beck specially for class work—on the lines of the foreign models, but made with a steadier foot, a larger stage, and mirror with a vertical adjustment.

FIG. 91.



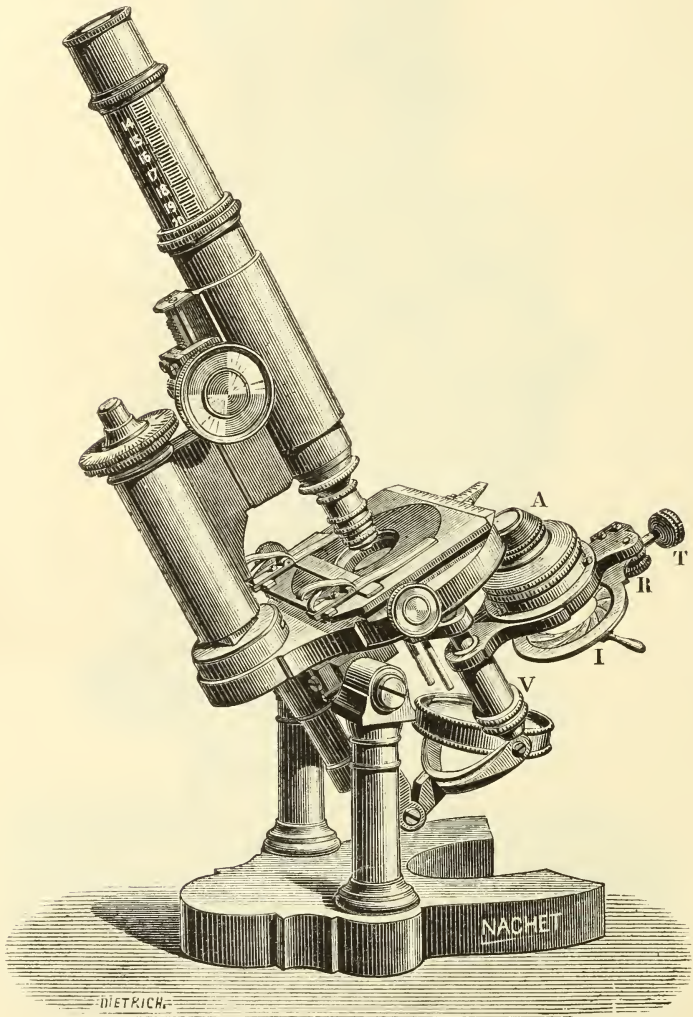
It is made in three forms:—Fig. 89, Sliding coarse-adjustment; fig. 90, rack-and-pinion coarse-adjustment; fig. 91, with swinging and focusing substage carrying Abbe condenser and iris diaphragm.

1892.

3 M

Nachet Microscope.—The large model No. 2, represented in fig. 92, is very solidly built, and possesses all the requirements necessary for microscopic work of all kinds. It can be inclined to the horizontal.

FIG. 92.

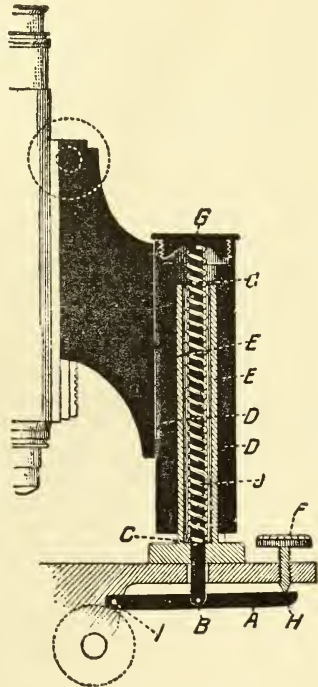


The stage rotates about the optic axis, and carries the movable slide-holder. The coarse-adjustment is by rack and pinion, and the fine- by

the new system of micrometer-screw,* with divided head indicating the 1/400 part of a mm. The double plane and concave mirror is mounted on joints. The draw-tube is divided into millimetres.

The whole illuminating system, consisting of a wide-angled Abbe condenser (N.A. 1.40) with iris diaphragm, is raised or lowered by the screw V. The iris diaphragm is mounted on the wheel R, worked by the tangent screw T, which by a very slight movement causes the aperture of the diaphragm to pass from the centre to the periphery of the condenser. The handle I serves to open and close the diaphragm.

FIG. 93.



Fine-Adjustment of the Beck Pathological Microscope.†—The fine-adjustment of Beck's new Pathological Microscope is stated to be one of the most sensitive and delicate fine-adjustments yet produced. It is constructed as shown in the accompanying figure. The body of the instrument is supported upon the barrel D D; this barrel is accurately and smoothly fitted to the triangular core E E. At the top of the barrel D D is screwed the cap G, to which is attached the rod C. This rod passes through the centre of the core E E, and connects with the lever arm A at B. The action of the spring J which is wrapped spirally around the rod C raises the body of the Microscope and holds the lever arm A tightly against the screw arm F. The slightest motion, therefore, of the screw F is communicated through the lever A and the rod C to the body of the Microscope.

The great delicacy of this arrangement will be appreciated when it is noticed that the distance from I H is double the distance I B, therefore any motion at B is only half that at H. This adjustment is one of the most delicate made for use with high powers.

(2) Eye-pieces and Objectives.

A Recent Improvement in the Microscope.‡—"L. H." writes as follows:—"I purchased some time back a valuable Microscope, which cost over 20*l.* with accessories, but I was not satisfied with it, and neither have I ever been satisfied with those instruments exhibited at London microscopical *soirées* at Morley Hall, Hackney, although of celebrated manufacturers. The Zeiss lenses, also, have not come up to

* See this Journal, 1886, p. 837.

† Microscope, xii. (1892) pp. 183-4.

‡ Engl. Mech., lvi. (1892) p. 17.

my standard of excellence, or liking. What I wanted to attain to was simply this: to be able to look through the tube as though there were no glass or medium in it; for it to be absolutely transparent or translucent, absolute distinctness of detail, edges of objects absolutely sharp and defined, the same with bubbles of air in mounts, to be able to see the surface of the finest polished glass-films with any power, and to see the depth of an object at the same focus. After many experiments with diaphragms, at last I said to myself; achromatic lenses are made of flint and crown-glass; the refractive index of flint is 0.026; its dispersive power, 0.052; some specimens refractive power of 0.029, dispersive power, 0.048; that of crown is 0.038 dispersive power, 0.018 refractive power. The refractive index of Canadian balsam is 0.021, dispersive power, 0.045. The refractive power of castor-oil, 0.018; dispersive power, 0.036. After reckoning up the probable results of gain from these indexes, I concluded that after opticians have corrected the colour and achromatized, or made achromatic their lenses, they required to be further balanced and more nicely balanced than they have been in regard to their refractive and dispersive power. On experimenting, I found that in the Microscope a material element was the place of its being used, and that although Canadian balsam was more whitish to the eye, it dispersed nine times and refracted three times too much to make an even balance. It does not give good results when used on object-glass in any way. On carefully cleaning with spirits of wine an achromatic lens of the same size as the body of the Microscope-tube, and cementing them together with castor-oil and fixing them at the end of draw-tube, judge of my delighted surprise when I found I had thereby attained more than everything I wished for with my Microscope, and equally attained it whether I used 2-in., 1-in., 3/4-in., 1/2-in., 1/4-in., 1/8-in., or 1/25-in. object-glass. The tube of the Microscope was absolutely translucent, and I could look through it as if it contained no glasses whatever. Field of view absolutely flat; focus of lens at end of draw-tube $8\frac{1}{2}$ in.; full length of Microscope-tube a little over 1 foot. Castor-oil as an immersion does not act properly. On testing Canadian balsam with a telescope of 2 feet and $1\frac{1}{2}$ -in. object-glass, and comparing it with the object-glass cemented with castor-oil, the latter gave incomparably best results. I can see the flies playing in the air between the line of sight and the buildings or conservatories in the distance."

On this we need make but few remarks, for, as is well known, the action of a lens at the end of the draw-tube has been advocated and tried *ad nauseam*. Dr. Piggott's "Aplanatic Searcher" is practically one of the instances; it was about to revolutionize the practical optics of the world, only unfortunately it failed and is nowhere to be found to-day.

It is possible that the " $8\frac{1}{2}$ -in. lens" at the bottom of the draw-tube may, by reducing the power of the optical combinations used, slightly increase the light and so produce what by contrast is a sharper picture, but a mere change to a lower eye-piece would have done the same.

The refractive indices appear to be wrong; but, neglecting this, the film cementing two lenses together is of necessity very thin and has *parallel* curves; therefore assuming that the writer *is* correct in his

statement about Canada balsam and its refractive index (which is against all that the best authorities have discovered, viz. that the refractive index of Canada balsam is μ_D 1.540) involving a dispersion of nine times and a refraction of three times too much for optical balance when compared with castor-oil, yet the effect of a *thin* film with parallel surface cannot be sufficient to make *any* perceptible difference.

Castor-oil, moreover, crystallizes, and is practically unsuitable for a permanent cementing medium.

(3) Illuminating and other Apparatus.

Standard Glass and Speculum Metal Centimetres.*—Dr. M. D. Ewell writes:—"I have ruled two centimetres on speculum metal subdivided into millimetres, the first millimetre into 1/10, and the first 1/10 mm. into 1/100 mm. These were sent to Prof. William A. Rogers several months since for investigation as to total length.

The five glass centimetres similarly subdivided, which were made the subject of a communication at the last meeting, have been in my possession the last three or four months, but are now in the possession of the Treasurer. My experience with glass micrometers has been such as to lead me to delay their investigation till sufficient time has elapsed to ensure their durability.

The lines on the five centimetres above referred to are still in as good condition as when made, and bid fair to be permanent.

The lines on the Fasoldt centimetre No. 2 (glass), upon which so much time was spent some years since by myself in comparing it with 'Centimetre A,' have so deteriorated as to make it entirely worthless for micrometric purposes, notwithstanding they are covered, and therefore not exposed to the deteriorating influences operating upon ordinary glass micrometers. Owing to the uncertain life of such scales, it has been thought wise not to bestow so much labour upon the five glass centimetres above referred to till more time has elapsed. I have, however, in order that they may be available for present use, compared the first 1/10 mm. of each of said scales with the first 1/10 mm. of 'A,' and deduced the following provisional corrections, which are the mean of ten measurements of each space.

The comparisons, of which the following are the results, were made by means of a Bulloch Professional stand No. 2, a Zentmayer filar micrometer, and a Bausch and Lomb one-half opaque illuminator, with daylight received from the right of the instrument:—

Scale.	Correction to First 1/10 mm.	Correction to First 1/5 mm.
Ewell .. I.	— 0.5	Not determined.
" .. II.	+ 0.0	+ 0.4.
" .. III.	— 0.4	—
" .. IV.	+ 0.2	Not determined.
" .. V.	— 0.5	" .. "

* Proc. Amer. Soc. Micr., xiii. (1891) pp. 71-2.

The two speculum-metal centimetres above referred to, with their investigation as made by Prof. Rogers, will subserve the purpose of substandards, and the five glass centimetres can be used by observers for the verification of their glass stage micrometers, so that there need be hereafter no occasion to use 'Centimetre A,' except as a final standard of reference. I would therefore respectfully recommend that 'Centimetre A' be deposited with the Superintendent of the United States Coast and Geodetic Survey, and that hereafter the two speculum centimetres be the *working standard* of the American Society of Microscopists."

Revolving Stage for Viewing Microscopic Sections, &c.*—Dr. T. Taylor, the chief of the Division of Microscopy in the U.S. Department of Agriculture, has devised a stage of which he gives the following account:—

"This plate exhibits a view of a new and improved form of revolving brass plate which I have recently devised in order to supply a need long felt in the division. It may be attached to any Microscope, and is designed principally for reviewing and comparing serial sections and textile fibres. This revolving plate is pivoted upon the substage by means of a downward-projecting pin. It may thus be rotated freely at the pleasure of the operator. Slides mounted with subjects for investigation and comparison are secured by means of spring clips upon the surface of the plate.

A stage of this description which I am accustomed to use exhibits eleven different samples of wools. In jury trials relating to wools I have found it sometimes desirable to have six Microscopes in use at one time in illustrating the respective characteristics of various samples of wool. Even with this number the parties are seldom satisfied, as one person is obliged to move from one instrument to another, interfering, perhaps, with the view of other observers. The system I have initiated saves much time—an important consideration in the court-room. By means of the revolving plate eleven diverse samples may be compared in less time than an observer could move from one Microscope to another.

Six stands of this model were on exhibition at the fourteenth annual meeting of the American Microscopical Society, recently held in this city, and the invention gave universal satisfaction. The publishing committee of the society have requested a description of this plate for the forthcoming volume of Proceedings.

I use a similar form for high powers, consisting of perfectly clear glass 2 mm. in thickness, circular in form, like the preceding, and, like it, attachable to the plane stage of a Microscope. On this plate the objects may be arranged upon its margin, the same as on the usual glass slides, and the cover-glass fixed upon them, thus dispensing with clips, which interfere somewhat with the objective when using high powers. Or the plate may be perforated, as in the metal plate, the mounts fixed by means of wax or a drop of paraffin at the edges of the slides. This method, I find, renders the object sufficiently steady for examination, and the wax has the advantage of being easily removed when it has answered the purpose, leaving a clean plate for change of subject or

* Report of The Microscopist for 1891, pp. 413-4.

for further investigation. The diameter of the revolving plate is only limited by the construction of the Microscope-stand, to which it is an adjunct."

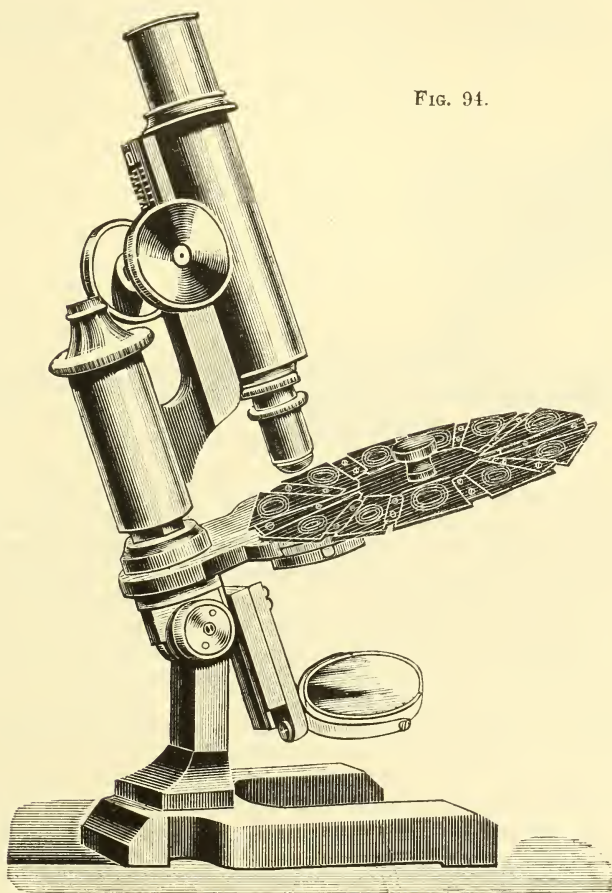


FIG. 94.

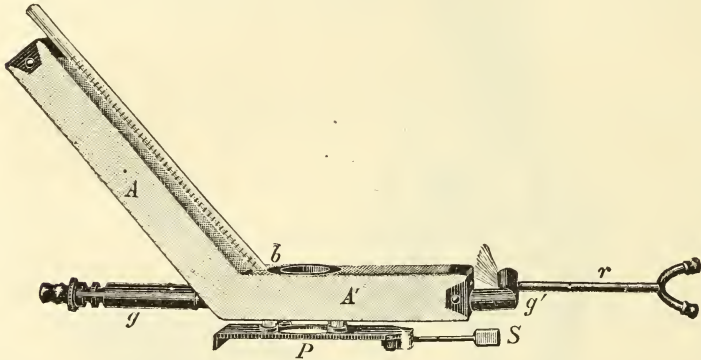
Heating Apparatus for Crystallographic Optical Work.* — Herr R. Fuess describes three forms of heating apparatus which serve for the optical examination of crystals at high temperatures.

The first apparatus, represented in fig. 95, is intended for temperatures up to 450° , which can be measured by a mercury thermometer. It consists of a box formed of a bent brass tube, of rectangular section, through which a stream of hot air is led. The arm A' which rests upon the stage of the Microscope serves as air-bath for the crystal under examination, while the other, directed upwards, acts as a chimney through which the heated gases escape.

* Neues Jahrb. f. Min., Beilage Bd. vii. (1890) pp. 406-16.

Near the bend at *b* the tube is cut through; and in the circular apertures fit glass plates which give passage to the light, and serve to protect the objective and condenser. Between these plates in the middle of the box is the crystal holder which consists of a small strip of glass resting on two supports. The whole box is coated with asbestos in order

FIG. 95.



to reduce the radiation, as well as to protect the hands of the observer from contact with the hot metal. For the further protection of the Microscope, the plate *P*, which rests upon the stage, is coated with asbestos on its under side, and is connected with the heating apparatus by four glass feet. In the case of large instruments with movable stages, the apparatus is fastened to the stage by the binding screw *S*.

The heating of the crystal is effected by a Bunsen burner *g g'*, the tube of which cuts through the inclined arm of the box, and lies with the greater portion of its length in the horizontal part. At *g'* it is bent at a right angle, and the part opposite the opening of the box is slit for the exit of the gas, which burns with a broad blue flame.

The position of the burner can be adjusted so that the flame approaches or separates from the object. By this means a very precise regulation of the temperature can be effected.

At the bend of the burner a tube *r* can be inserted which serves for the introduction into the box of water vapour or cold air. For this purpose the two branches of the tube can be connected respectively with a flask of boiling water and with a bellows. By the latter a rapid cooling can be effected, or a blowpipe flame produced when a tube with circular opening is fitted over the ordinary slit of the burner.

The reservoir of the thermometer is in the shape of a horse-shoe, the two arms of which rest on the object-holder, and enclose a space of about 7 mm. square which is occupied by the crystal, so that a uniform heating of thermometer and crystal is assured.

The second apparatus, represented in fig. 96, is for temperatures up to a red-glow. The source of heat is an electric current passing through two pieces of platinum foil. On a rectangular stage of slate, with wide

central aperture, are screwed two brass plates $P P'$, isolated from each other. Attached to the plate P' is a small bracket l , the wedge-shaped pointed end of which projects slightly over the edge of the central aperture of the stage, and carries a small projecting pin.

A second similar bracket l' can be screwed over the first by the screw r , so that the pin of l fits into a corresponding hole in l' .

Opposite the clamp thus formed by l and l' , is a similar one $L L'$, carried by the plate P . This clamp, however, is not rigidly fixed like the first, but can be made to approach it to a certain extent by pressing on the end against a spring attached to the under side of P .

The two clamps serve to stretch between them the two pieces of platinum foil B , which are pierced in the centre with small apertures. After removal of

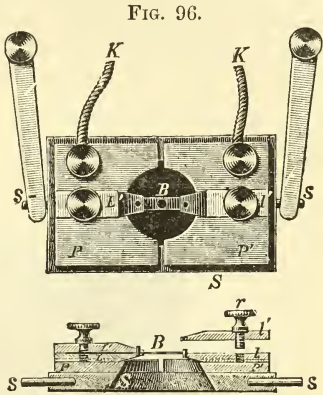


FIG. 96.

the upper parts $L' l'$, the clamps are brought closer together by pressing against the spring, and the two pieces of foil are placed upon the lower parts $L l$, so that the projecting pins pass through corresponding holes in the foil. The upper parts are then put on, and the pressure on the spring is released, so that the pieces of foil are firmly stretched, and form a metallic connection between the plates P and P' . The crystal plate is inserted between the pieces of foil and the pressure due to the spring suffices to hold it firmly in position, even when the Microscope is directed horizontally. For greater security, however, the lower piece of foil is provided with a small projecting rim. The apparatus is attached to the Microscope-stage by the ordinary clips, which press upon the pins $s s'$ projecting from the plate of slate. The electric current is brought by the wires KK , which are screwed to the plates P, P' . In the Berlin Mineralogical Museum, the current is supplied by a Raub thermo-battery, which produces a current of 15 ampères, with electromotive force of 3 volts. A rheostat is used for the regulation of the temperature.

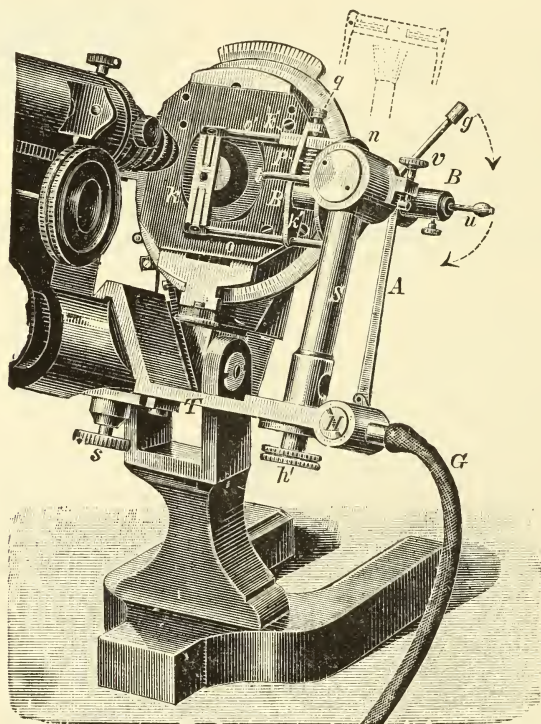
For observation with convergent polarized light at high temperatures, the lens fastenings of objective and condenser must be protected with capsules of horn or paper; but even with this precaution a close approach of condenser and objective can only be allowed for a very short time.

The apparatus is, therefore, not well adapted for observation between crossed nicols in convergent light, and can only be used with advantage for small crystals.

The third apparatus, heated by gas, for observation with parallel and convergent light at high temperatures, is intended to remedy these defects. It differs from the two just described in so much that it is not connected with the stage of the Microscope, and so cannot be rotated with it. It is therefore most conveniently used with a Microscope such as that of Dick and Swift, in which the two nicols can be

simultaneously rotated while the stage remains fixed. The apparatus, which is represented in fig. 97, is carried by a support T attached by the screw *s* to the fine-adjustment column of the Microscope. On the end of the support rises a hollow column S, terminated by a hollow axis which carries the burner B B'. The latter can be brought into the vertical position, which is shown dotted in the figure, by means of the handle *g*, and it is always in this position that the crystal is heated. The gas

FIG. 97.



brought by the tube G passes through the cock H into the column, and thence through the axis to the burner B. At the foot of the column are holes for the admittance of air, which can be regulated by means of a second cock *h*'. The arrangement of the crystal holder is somewhat similar to that adopted in the second apparatus. As in that arrangement the crystal is held between two pieces of platinum foil, the middle portions of which form square plates, pierced by central apertures. From the square central part of one of these plates there project on each side two arms, the ends of which are riveted to the under surface of the steel rods *o o'*. From the middle part of the second plate two arms project between the arms of the first plate, and are riveted to the upper surface of the steel rods. The arms of the two plates are thus separated by the thickness

of the rods; and when the latter are driven apart by the effect of the spiral spring P, the central parts of the plates are pressed together and firmly clamp the crystal placed between them. The opening of the clamp is effected by means of the screw *q*, which presses upon the rod *o'*, jointed to the plate *n*. The crystal is oriented by means of the horizontal displacement of the holder, and its rotation about the axis at the head of the column, which is regulated by the screw *v*. After the orientation of the crystal, and adjustment of the objective and condenser, the burner is brought into the vertical position, and the crystal is heated. It is then quickly turned back again, and by means of the stop of the screw *v* the crystal keeps its former orientation. On turning back the burner, the flame is at the same time extinguished by the rod A acting upon the cock H, and cutting off the gas supply. When the burner is brought back again to the vertical position the cock is again opened, and the burner re-lighted by means of a small gas flame, fed by the tube *t*, which is kept constantly burning. In the burner is a small tube *u*, communicating with a bellows, which serves either for the production of a blow-pipe flame, or for the cooling of the apparatus.

The Reflector with the Projection Microscope.* — Mr. G. B. Buckton urges the advantages of a catoptric as compared with a dioptric arrangement in the following letter:—

“The lantern is now used for so many purposes—scientific, photographic, and recreative—that any improvement in its construction will be acceptable. When we look into this instrument whilst at work we must be disappointed at the large quantity of light lost by reflection and by dispersion—light which ought to go to the illumination of the screen. In the ordinary form of the lantern three lenses of dense glass are employed as condensers. Each of these six surfaces reflects and scatters the light, and the glass itself is absorbent of its rays.

The dioptric construction of the projection lantern has been well worked out by Messrs. Wright, Newton, Salomons, and others, but the catoptric principle, which would eliminate almost entirely these disadvantages, has been scarcely at all studied.

Although my experiments have been made solely with the limelight in various forms, the following remarks may equally apply to light given by the electric arc:—If a reflector be used instead of the ordinary condenser, it is obvious that the position of the lime cylinder must be reversed. This will present no difficulty, for the tube holding the jet can be bent into a helical form. The dark image of the lime cylinder also will have no more practical disadvantage than is experienced by a like image formed by the small plane speculum of the Newtonian telescope.

As to the mirror itself, although a parabolic form is the most correct, a spherical surface will be sufficient for mere illuminating purposes, and thus expense may be spared in the grinding of the more difficult curve. A speculum of from 5 to 7 in. diameter, having a radial curvature of from $2\frac{1}{2}$ to 3 in., will grasp a large quantity of light, much more than that obtainable from the 5-in. condenser usually employed.

Silver deposited by one of the various reducing processes on the

* Nature, xlvii. (1892) pp. 54-5.

surface of a clear glass lens will have many advantages over a metal mirror. The front surface will give, perhaps, the finest definition, but by silvering the back part of a spherical glass film, or that of a ground lens, the brilliant portion will remain untarnished for an indefinite time, and the whitish bloom formed by slow volatilization of the incandescent lime is easily removed. This silver film adheres with remarkable tenacity, and it will bear a great deal of heat without blistering or becoming detached. I have had considerable success in constructing such mirrors from the large ornamental glass spheres blown in Germany, and silvered within by Liebig's process, viz. with milk, sugar, and ammonio-nitrate of silver.

A glass sphere of 10 or 11 in. in diameter may be easily cut into eight or nine mirrors by a red-hot iron, and this without disturbing the silvering, which will require only gentle friction with a pad of cotton impregnated with a trifle of rouge to brighten it. Thus, at the cost of a few shillings, eight or more mirrors can be made, and also provision be made against possible accidents of cracking by heat.

The light-radiant is so placed that the secondary focus is intercepted by a plano-concave lens of dense glass, as has been happily proposed by Mr. L. Wright. The convergent rays from the speculum are thus made into a parallel beam, which must be deprived of its heat by an alum trough, for the light and heat at the substage condenser are very great.

Convergence, I find, is usefully promoted by a plano-convex lens of about 8 in. focus placed two or three inches before the above-noted plano-concave lens. In all other respects the arrangements are like those of the usual modern projection Microscope.

I have pretty constantly used the ether-oxygen saturator, and I consider it to be perfectly safe if ordinary precautions be taken. The oxygen, compressed in cylinders, is much recommended, as there can be no mixture of vapour, except at the right place. The U-shaped horizontal saturator, plugged with flannel, must be well charged with ether, or with the best gasoline, and care should be taken, before beginning or ending an exhibition, to shut off the oxygen-tap before closing the ether-tap. This will prevent the harmless 'snap' from the mixture in the small chamber at the joining of the gas-tubes. If a disc more than 8 ft. be required for the Microscope, it will be well to use hydrogen gas instead of ether, since the calibre of the jet cannot in the ether light very well exceed $1/14$ in. As an extra security I pack the mixing chamber with asbestos fibre moistened with glycerin; but, as before urged, the oxygen must leave the saturator saturated.

To ensure the coincidence of the foci of the reflector with the optical axis of the Microscope it will be well to place three adjusting screws in a triangle behind the mirror, and this last may have both a small vertical and horizontal movement. I claim for this catoptric arrangement a larger grasp of light than can be got from ordinary lenses, and this may be effected also at a small outlay. For the amateur constructor the plan will afford many advantages."

(4) Photomicrography.

Processes of Photomicrography.—The following is the text of Dr. Piffard's letter, read at the October Meeting:—"In the last issue

(April) of the Journal, Mr. Gifford, in connection with the resolution of the Amphipleura, advances an idea which is probably novel to many, namely, photomicrography by means of monochromatic yellow light. As I have personally worked in this direction for some time, and have carried the idea a step farther than Mr. Gifford appears to have done, I take the liberty of bespeaking the courtesy of your pages. I will briefly relate the main facts which led me to the processes I now employ in photomicrography, and which in low power work give me results vastly better than those at present in vogue, although in high power work I have not as yet observed the same advantages.

In 1873 I purchased a No. 4 Hartnack objective (about 1/2 in.). It was a glass of quite moderate angle but otherwise good of its kind. Employed in photomicrography, using the then customary collodio-iodide wet plate, the results were not satisfactory. About 1878 I purchased a Wales 4/10-in. Ang. Ap. 90°. This lens was and is still a remarkably good glass to look through, but it utterly failed to give a satisfactory result when used photomicrographically at the time of purchase. Five years ago I tried it again, using the now customary and ordinary gelatin-bromide dry plate. The results were disappointing. About four years ago I became interested in the so-called orthochromatic plates, and as they were not at that time an article of commerce in this country, was obliged to prepare my own, and succeeded in preparing such as were equally sensitive to blue, green, and yellow, and almost wholly insensitive to violet and ultra-violet. I also made such as were remarkably sensitive to yellow, but hardly at all to the other colours. The methods employed were published by me a few years ago in 'Anthony's Photographic Bulletin.' The commercial plates now obtainable in this country are markedly sensible to yellow, less so to blue, and still less so to green. On the whole they are of better quality than similar plates of English manufacture that I have tried, though not equal to some Vogel-Obernetter-Perutz plates that I once had the opportunity of using.

About ten months ago I asked Mr. W. Wales to make me some low power objectives specially corrected for photomicrography. He did so, but the lenses did not satisfy me, and I retained but one of them. I subsequently asked him to make me a 1/4 in. When he brought the lens he said, 'I have put this in a rough mounting in order that you may look through it as it is before I finish its correction for photography, as I shall undoubtedly impair its visual performance to a certain extent.' He further said, 'I think it is the best 1/4 in. of its angle (75°) I have ever made.' On visual examination (Podura) the lens left little to be desired, but being curious to see just how far 'off' it was photographically I made a negative using a commercial (isochromatic) plate. The result was a gratifying surprise. On reporting the matter to Wales he said, 'I do not understand it, the lens in the condition in which I gave it to you ought not to have photographed so well.' For comparison I photographed the same scale with a Powell-Lealand 1/4-in. water-immersion N.A. 1.26 which I have owned for several years. The resulting negative was not equal to that made with the lower angle Wales.

I believe it is generally maintained, and I think with justice, that

the Zeiss apochromatics are not visually superior to first class achromatics of some other makers; but it is also admitted that they have usually given better results photographically.

A few months since I made a critical examination of the colour corrections of my Zeiss 2-mm. apochromatic and I found it slightly over-corrected. The same was true of two other Zeiss apo's. My Wales 1/4 in. was also over-corrected. Reflecting on the facts herein narrated I was led to the provisional induction that to get the best results with orthochromatic plates the lenses should be over-, rather than under-corrected.

To confirm or refute this induction I next tested the 4/10-in. Wales and No. 4 Hartnack, both over-corrected, and found that their performance was much better with orthochromatic than with plain plates. There was, however, something still lacking; the negatives did not possess the absolute sharpness that was desired. The defect in definition especially noticeable at the margins of the picture I attributed to unequal magnification by rays of different refrangibility. To overcome this I excluded the blue, violet, and ultra-violet rays by means of a suitable ray-filter. The one that proved the most satisfactory was a solution of tropæolin (Grubler's 000). This permits the passage of the red, orange, yellow, and a portion of the green. The advantages gained by its use were great, but still were not equal to theoretic demands. To carry out these practically to the fullest extent will require an absolute harmony in illumination, in lens, and in plate, each being adjusted so far as possible to the rays of the same refrangibility. In former times the photographic plates then in use were sensitive only to the G, H, and ultra H regions of the spectrum, and lenses were under-corrected in order to bring the more refrangible actinic rays into coincidence with the more powerful visual ones from the D region.

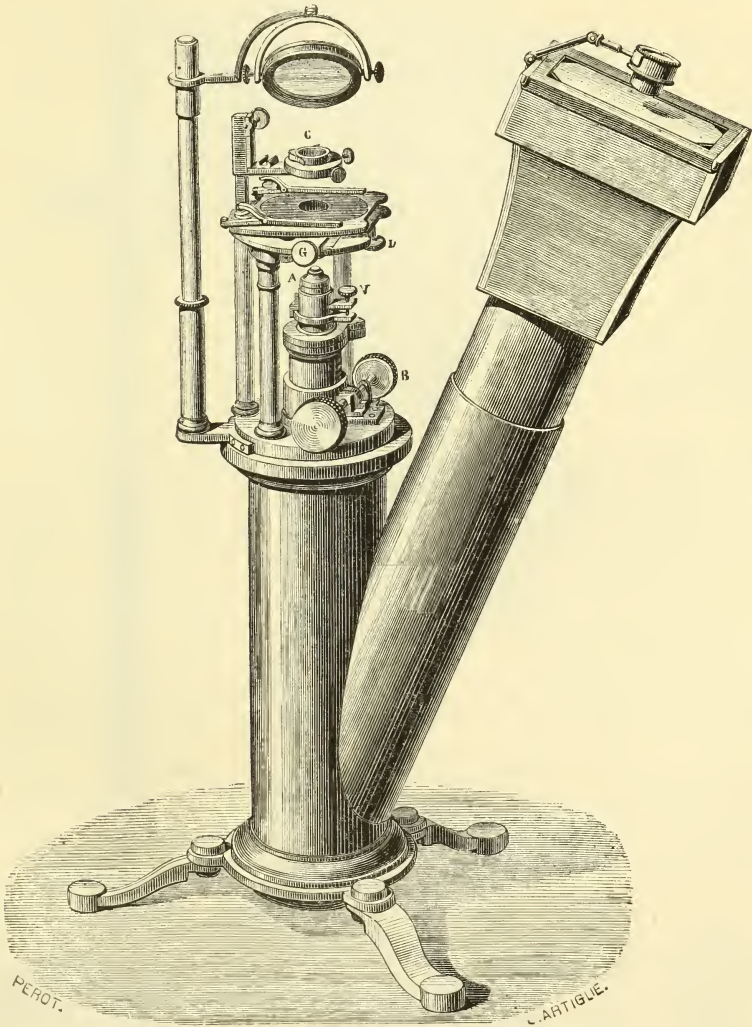
Inasmuch as the present orthochromatic plates are capable of giving results utterly unattainable on plain plates, I am satisfied by practical experience as well as theoretically, that the photomicrography of the future will advance considerably over that of the past if the D region be selected as the standard for illumination, for the sensitiveness of the plate, and for the correction of the objective. The first may be secured by suitable absorptive solutions or the employment of monochromatic yellow light obtained by prismatic or diffraction dispersion. Plates specially sensitive to D light are readily accessible, and there is therefore no difficulty in fulfilling the second indication. The third requirement will necessitate a slight modification of the formulas usually employed by the leading opticians. Mr. Herbert R. Spencer, son and successor of the late Chas. A. Spencer, is now making for me a 1/6 homogeneous immersion specially corrected to the end in view."

Nachet Photomicrographic Apparatus.—The instrument shown in fig. 98 consists of the large model inverted, with camera attached to the side-tube. The distance between objective and eye-piece amounts to 1.20 m. The mirror is silvered, so that the loss of light is insignificant, and the highest objectives can be used.

By reason of its absolute stability and the facility which it offers for very oblique illumination, this instrument is particularly adapted for photographing diatoms. The focal adjustment and arrangement of

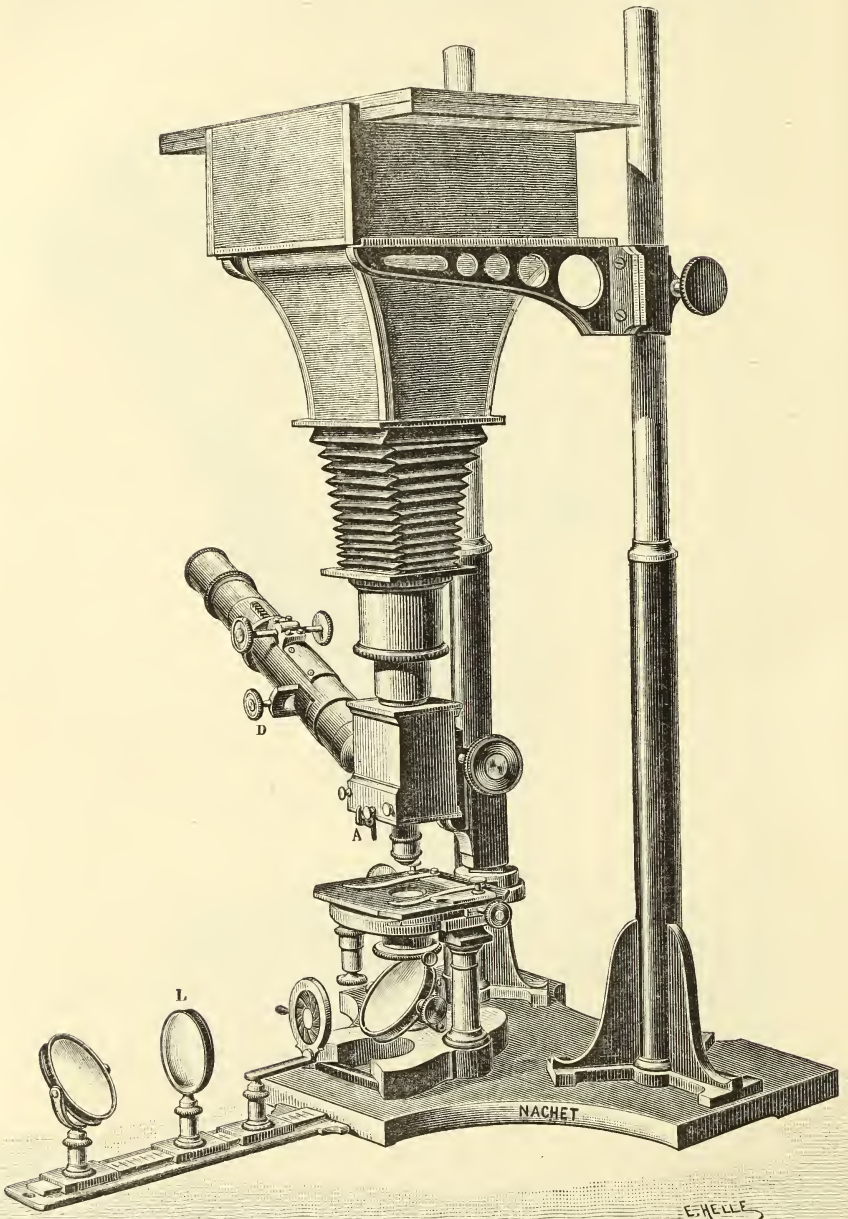
the illumination can be made with the greatest ease during the examination of the image. For preliminary observations the camera can be easily replaced by the eye-piece.

FIG. 98.



The latest form of the apparatus for the instantaneous photography of moving objects is shown in fig. 99. It consists of a camera mounted on two supports which slide on columns attached to the base of the apparatus. The camera is connected below with a Microscope of special construction, which enables the observer to examine

FIG. 99.



the objects while the sensitive plate in the shutter is ready to receive the photographic impression. The details of the arrangement have already been described in this Journal, 1886, p. 842.

In front of the Microscope is a stand on which are mounted a mirror, a condensing lens, and an iris diaphragm, which serve for the proper regulation of the light.

Microscopical Illustrations.*—Mr. H. L. Tolman writes:—"One of the most difficult features in connection with the illustration of scientific articles is the reproduction of the photomicrographs or camera-lucida drawings. If the object contains a large amount of detail, a photograph will be the only way by which all the minutiae can be preserved, but no woodcut can entirely reproduce the original. Of course, it is not always necessary that everything which is seen under the Microscope should be seen in the book illustration, and just here is the point where authorities differ on the requisites of a good woodcut or engraving. Some hold that only the salient parts of an object need be represented; in fact, that the picture is better for having omitted from it all but the few leading features, to which the writer desires to call attention. Others claim that the picture should represent just what the eye sees under the Microscope, free from any of the possible or intentional errors of the artist. There is, undoubtedly, much to be said on both sides of the question.

Those who have studied the astonishing cuts called "diagrammatic representations," the counterpart of which they vainly search for in nature, will be strongly in favour of any method which reproduces an object so that it can be recognized, and the tendency of the art of the present day seems to be in this direction. Fortunately, with this demand comes an improvement in the manner of reproducing photographs and drawings of every kind, which deserves a somewhat extended notice. This is by what is known as the half-tone process, which consists of a photographic copy of the original on a zinc or copper plate and then etching the plate until the drawing appears in relief, and is printed from like an electrotpe. In order to convert the smooth, soft shades of a photograph into a form which will prevent them from printing a solid black, they are broken up into a series of dots more or less close, by the interposition of a finely ruled screen in the camera just in front of the dry plate. On the character of this screen depends in great measure the quality of the finished picture, and the skill of the process worker is best shown by a proper selection of the screen to illustrate the landscape or portrait which is to be reproduced.

For bold subjects a coarse screen is appropriate, while for those with great detail and delicate graduations of shades a fine screen is required. These screens are either ruled on paper and copied by the wet plate process on glass or directly on glass, the lines varying in distance from 1/100 to 1/150 in. Obviously, for nearly all microscopical photographs the fine screens must be used, but it will be found that some of the contrast must be sacrificed thereby. Of course, there are some subjects which cannot be reproduced by the half-tone

* Amer. Mon. Micr. Journ., xiii. (1892) pp. 155-7.

process. Where the object is entirely novel and the peculiar grain-like structure of the picture might cause erroneous conclusions, where there is a large amount of fine detail, or where, as in diatoms, the structure consists of a series of fine lines, or minute dots, elevations, or apertures, then this process is not so applicable. But even here it is serviceable if only the general appearance of the object is desired. One suggestion may be allowed to be offered—that in studying all process work the best effect is given if the picture is held at a rather greater distance from the eyes than the distance of normal vision, i. e. ten inches. By this means the attention of the observer will not be distracted by seeing the individual dots or points of which the image is made up, but he will still be enabled to appreciate all the delicate effects of light and shade.

There are several methods in common use for producing what are called half-tone prints. The bitumen process, though commercially but little used on account of its slowness, is one of the best for reproducing detail, especially since Valenta has discovered some valuable improvements, while the numerous so-called enamel processes which have recently been introduced, modifications of the gelatin process, are valuable in that they are rapid and cheap. The cheapness, of course, is one of the strongest recommendations for the use of any half-tone process, as a cut which on wood might cost from 10 to 20 dollars could be put into a half-tone for 3 to 5 dollars. Another advantage is that the amount of detail in a picture would make no difference in the price of a zinc plate, it being sold for a certain price per square inch, while the cost of a woodcut would depend very largely on the fineness of the detail which was to be reproduced. This kind of illustration has already been largely used in medical work, and the A. M. M. J. a year or two ago republished some half-tone cuts by the author of photomicrographs of sections of woods, showing the capabilities of the process. For the representation of very delicate work, the numerous photo-gelatin processes are more satisfactory, as the minutest detail can be accurately shown, but they are much more expensive, and must be printed on special paper and presses. But graphic illustrations in some form add largely to the attractiveness of an article, as well as enabling the reader to comprehend at a glance the idea which is sought to be conveyed. Few can draw, but dry plates have made photomicrography almost a pastime, and the half-tone process offers, by all odds, the best mode of reproducing photographs with all the accuracy of the original, and with a minimum of expenditure of time and money, and it is to be hoped scientific periodicals will be led to make more use of this new method."

Drawing Photomicrographic Objects.*—Dr. H. G. Piffard has done much to simplify the drawing of photomicrographic objects, by means of his application of the prism to the Microscope. His method is to insert a right angle prism by means of a short tube in the place of the eye-piece of the Microscope, and on one of the square faces of the prism another short tube to hold the ocular. The object then having been placed upon the stage and focused, a piece of plain drawing-

* Anthony's Photographic Bulletin, xxiii. (1892) p. 516.

paper is placed under the ocular, and the room darkened, when a brilliant image will be apparent on the drawing paper. It is evident that in this way the artist has the advantage of perfect freedom, both of eyes and hands, and can trace the minutest detail with ease and accuracy.

The Microscope and a Hair.*—Two different men were suspected of making an assault, but no proofs were forthcoming. A single hair which was found on the clothes of the victim finally became the clue to the mystery.

The hair was photomicrographed and compared with photomicrographs of the beard and hair of each suspect. There was entire lack of similarity and the case was about to be abandoned. The hair was pointed and had never been cut. Other facts pointed to its belonging to a smooth-haired and comparatively short-haired dog. Inquiry revealed the fact that one of the suspects owned such a dog. A fresh hair agreed in every respect with the specimen. The owner of the dog could not explain away the facts, and was convicted. He confessed indeed to having committed the assault.

(5) Microscopical Optics and Manipulation.

Simple Method of Finding the Refractive Index of various Mounting Media.†—Mr. E. M. Nelson suggests the following method. "Provide two precisely similar equi-convex lenses, whose identical refractive index μ , and radii r , are known, and cement them together with the mounting medium whose refractive index has to be determined. Now measure F , the principal focus of the combination, then the refractive index of the mounting medium.

$$\mu' = 2\mu - 1 - \frac{r}{2F}.$$

It is convenient to make the radii of the equi-convex lenses 2 in. : then

$$\mu' = 2\mu - 1 - \frac{1}{F}.$$

Some examples might be of interest.

Let the refractive index μ of the two equi-convex lenses be $3/2$, and suppose that the combination has no focus, that is, that it behaves like a piece of plane glass, then

$$F = \infty, \frac{1}{F} = 0, \text{ and } \mu' = 2\mu - 1 = 2 \cdot 0.$$

If the principal focus of the combination $F = +2$, then

$$\mu' = 2\mu - 1\frac{1}{2} = 3/2,$$

or the same as that of the equi-convex lenses.

But if the principal focus of the combination F is negative, it must be measured in the same way as a concave spectacle lens, viz. by neutralizing it by a positive lens of equal focus.

* Microscope. xii. (1892) p. 176.

† Journ. Quek. Micr. Club, v. (1892) pp. 8-9 (with an addition by Mr. Nelson).

If F is negative, the sign before the fraction will be changed. Example, let $F = -2$. Then

$$\mu' = 2\mu - 1 - \frac{1}{2} = 2\mu - 1 + 1/2 = 2 \cdot 5.$$

The above method gives a greater range of readings for indices varying from 2.0 to 2.5, and consequently more accurate results than the simpler one of filling up a plano-concave lens with the medium, and covering it with a piece of plane glass. The formula for this latter plan being $\mu' = \mu + \frac{r}{F}$. The radius of the concave r might with

advantage be made 2 in., then $\mu' = \mu + \frac{2}{F}$.

If $\mu = 3/2$, and $F = \infty$, $\mu' = 3/2$; if $F = 4$, $\mu' = 2 \cdot 0$; and if $F = 2$, $\mu' = 2 \cdot 5$."

The following is a simple method of measuring the focus F :—On the stage of the Microscope place a slip with some scratch or mark on its lower surface. Screw a low power, such as a 1-in., on the nose-piece and bring this mark on the lower surface of the slip into sharp focus. Place the lenses with the enclosed medium on the substage of the Microscope, and by means of the substage rackwork carefully focus on the same scratch or mark on the lower surface of the slip the image of some distant tree or chimney-pot formed by these lenses. It will then be easy to measure the distance between the lower surface of the slip and the lenses, which will be the focus required. Note, if the Microscope is used in a vertical position it will be necessary to employ a mirror; care, therefore, must be taken to see that it is the *plane* mirror that is used; it would further be advisable to test the plane mirror by the sun's rays, as so-called plane mirrors are sometimes concaves of long foci, in which case they are unfit for use in the above measurements.

Abbe Measuring Apparatus for Physicists.*—Dr. C. Pulfrich describes three measuring apparatus for the use of physicists, constructed by Prof. Abbe. The instruments are not new, but have not been fully described before. In their construction the following principles were mainly considered:—

(1) The measurement in all cases, both by contact as well as by sight-adjustment, is made by means of a scale, with which the distance to be measured is directly compared.

In this way all irregular and uncontrollable errors, such as are to be feared in the case of screws, are avoided.

(2) The apparatus is so arranged that the length to be measured forms a direct continuation of the scale which serves as the standard of measurement.

By this means the comparison of the measured length with the scale is made independent of the greater or less perfection of the mechanism by which the displacement is made.

In all three pieces of apparatus the divisions are engraved on plates of platinum or silver, which are only fixed at one end, so that they are free to expand in all directions. The standard scales are divided into

* Zeitschr. f. Instrumentenk., xii. (1892) pp. 307-15. [The Society is indebted to Herr Zeiss for the use of the clichés of this article.]

1/5 mm., and every millimetre is marked by a figure. For readings below 1/5 mm. each instrument is provided with a micrometer-Microscope which is so arranged that two complete turns of the screw on the eye-piece correspond to one division of the scale, so that one division of the screw-head, which is divided into 100 equal parts, represents 1 μ . In the two instruments with contact adjustment the contact is effected by means of an agate pointer with spherical polished termination.

The contact micrometer represented in fig. 100 is intended to measure thicknesses up to 50 mm. by contact adjustment. The arm A, screwed to the base-plate of the apparatus, serves to support the Microscope, and also the arrangement for raising and lowering the scale. The platinum scale M, about 60 mm. long, is suspended at its upper end right and left between two points S. The lower end rests at the back against a projecting pin which is adjustable, so that the plane of the scale can be brought exactly into the line of displacement. This is the case when all the divisions of the scale during a complete displacement appear equally distinct, as seen in the Microscope. On the stand is a scale, divided in centimetres, on which the position of the zero point of the movable scale can be read with the naked eye. A smooth movement, as free as possible from friction, is obtained by means of two steel cylinders F_1 and F_2 , which pass through two three-sided openings.

The mechanism for raising and lowering the scale is easily understood from the figure. A cord fastened to the upper end of the cylinder F_1 passes over the pulley R to the grooved wheel J, which is turned by the handles H_1 and H_2 . The weight of the cylinders and scale is partly counterpoised by the small weight G.

The object of which the thickness is to be determined is placed on a glass plate, 7 cm. in diameter and 1 cm. thick, let into the base-plate of the apparatus.

The second instrument, the Comparator, represented in fig. 101, serves for the measurement of divisions, gratings, spectra, star photographs, &c., up to 100 mm. It differs from the last in that the length to be measured is adjusted optically by a Microscope instead of by contact.

On a short strong tripod (fig. 101) is screwed a base-plate 16 cm. long, and about a hand broad. This carries the supports for the two Microscopes I. and II., of which I. is adjusted upon the scale, and II. upon the object. Scale and object are attached to a slide dovetailed into the base-plate, and displaceable from right to left.

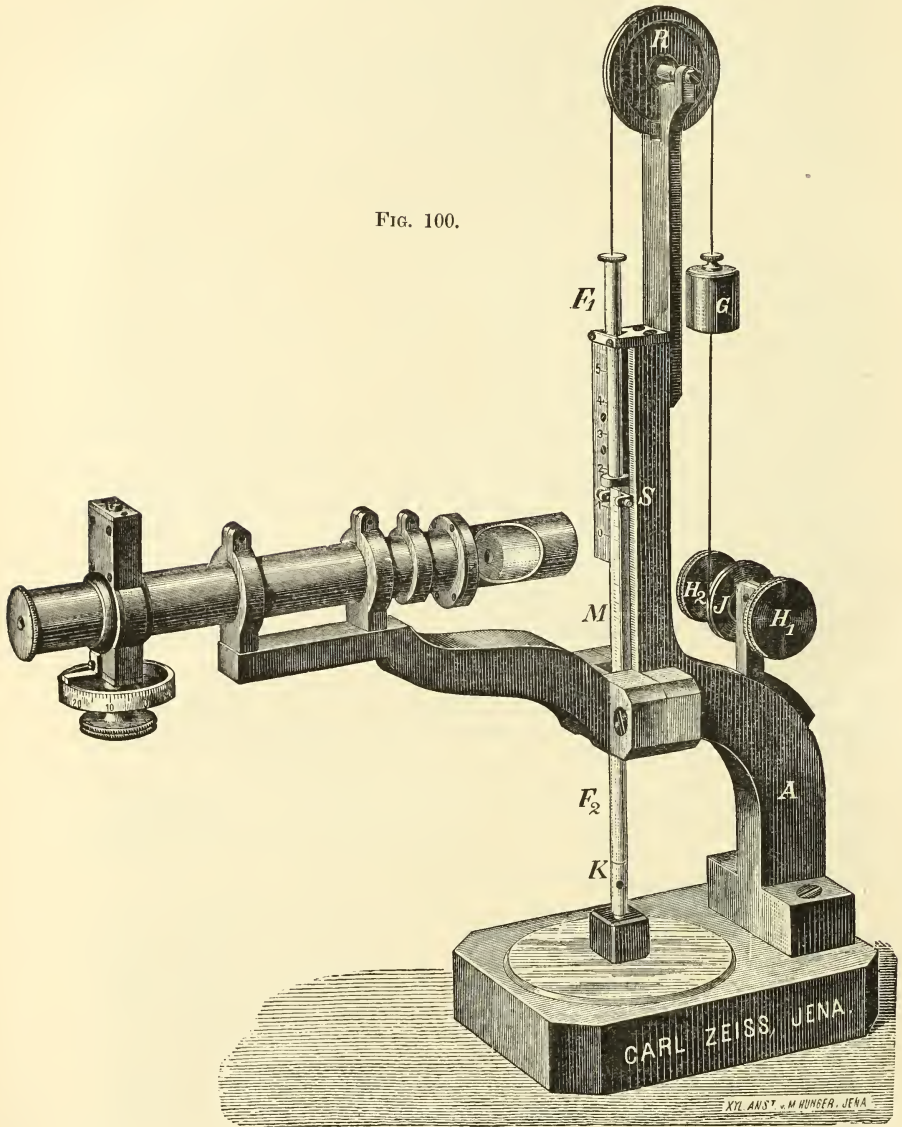
Large displacements are made by hand by means of the knob on the right. The finer movement is effected by the screw S_1 . The scale M is brought directly upon the slide A A. The object on the other hand lies on a second special slide B, which is connected with the main slide in such a way that it partakes of all the displacements of the latter, but can also be moved separately by means of the screw S_2 on the left.

For the observation of objects with transmitted light, half of the main slide near the object slide is cut away along its whole length. The illumination in such cases is by means of a mirror beneath the base-plate. Further, in order to render possible the examination of square and circular plates, the support of Microscope II. is curved out so far that the foot is more than 50 mm. from the middle of the slide.

For many purposes it is useful to fit upon the slide B a rotating plate,

on which the object is fastened. In the majority of cases, however, it is sufficient to fix the object with wax, and adjust by hand. The adjust-

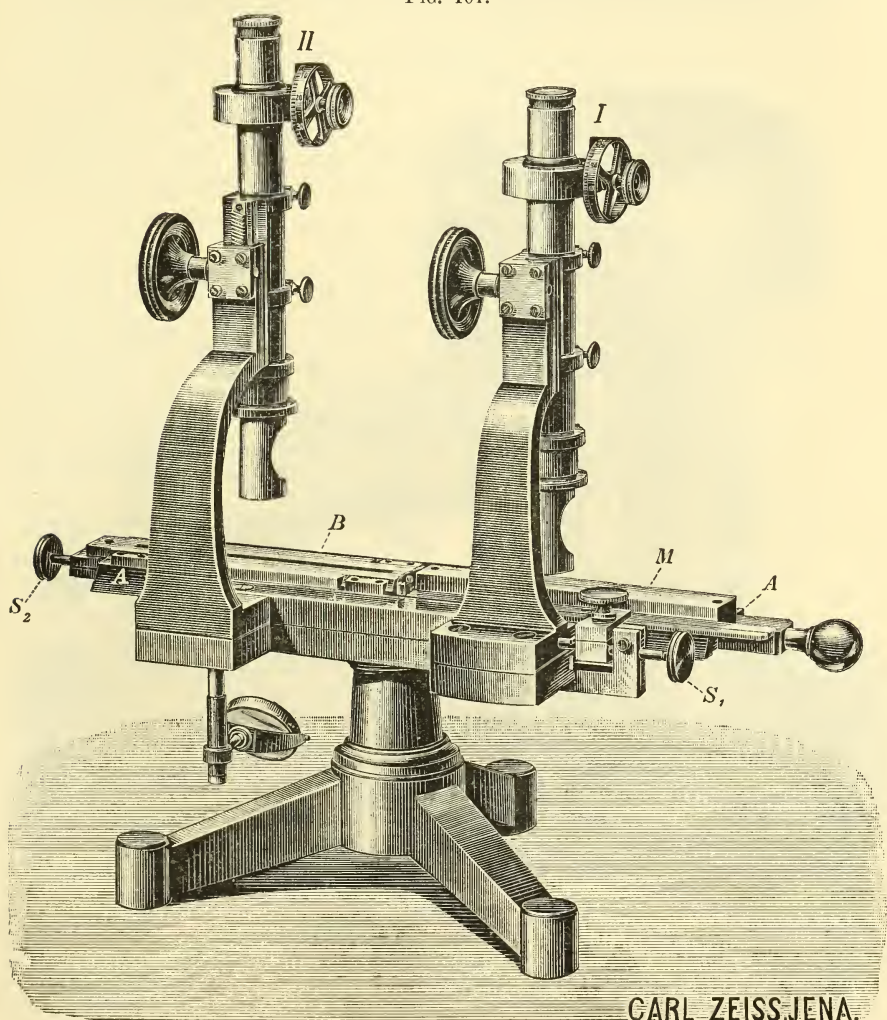
FIG. 100.



ments of the comparator can be quickly made. First, the scale M must be moved by means of the two adjusting screws on its free end until no deviation with respect to the Microscope is noticed during a displacement

of the slide through the length of the scale. Secondly, the double wire of the micrometer must be directed parallel to the marks of the division by turning the body-tube, after loosening the screws of the Microscope-holder. Thirdly, for avoidance of parallax, the image of the division must be brought exactly in the plane of the double wire.

FIG. 101.



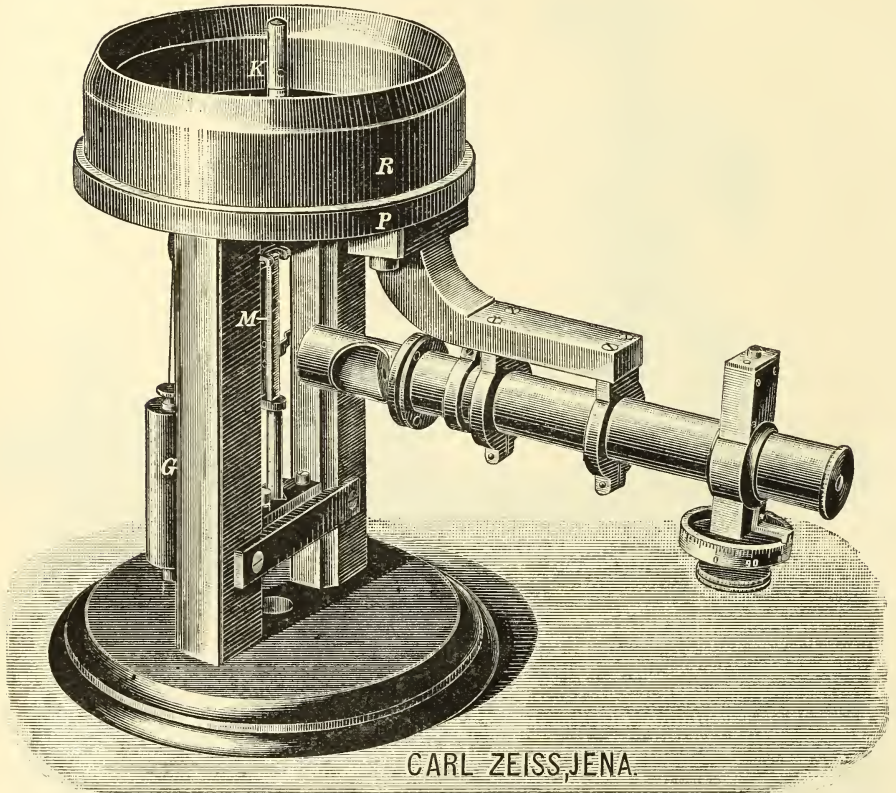
CARL ZEISS-JENA.

For the adjustment of Microscope II. the slide is moved so far to the left that the first divisions of the scale come beneath the Microscope. The double wire is then directed parallel to the marks of the division,

so that the double wires in both Microscopes are parallel. The course of the measurement is similar to that in the comparator.

The third instrument is the spherometer, shown in fig. 102. In principle it is the same as the ordinary spherometer, the radius of curvature R being given by the formula $R = r^2/2h + h/2$, where h is the height, as measured by the instrument, of a dome with base of known radius r ; but, as in Mr. E. M. Nelson's instrument, described in the October number

FIG. 102.



of this Journal, p. 670, for the usual tripod arrangement is substituted a ring on which the lens to be examined rests. The steel ring R fits into the plate P , supported on two strong uprights, and can be replaced by other rings of less or greater diameter. The base-plate of each ring is provided with a cylindrical boring which fits on to a cylinder screwed to the plate P , so that the central position of the contact point K is in all cases ensured.

For greater security against wear and tear, each ring is formed of two edges about 1/2 mm. apart.

In other respects, viz. in the means for raising and lowering the scale and contact point, the apparatus is similar to the contact micrometer, and so far differs from Mr. Nelson's instrument, that no micrometer-screw, with its possible errors of back-lash, &c., is made use of. The error, common to all spherometers, and due to the fact that the contact circle of steel ring and spherical surface is not exactly coincident with the edge, so that the measurement of h for concave surfaces is too low, and that for convex surfaces too high, is found to diminish the greater the diameter of the ring. Accordingly, a ring of the largest possible diameter should always be used, and, in the case of lenses with surfaces of equal but opposite curvatures, the mean of the readings for the convex and concave surfaces should be taken as the value of h .

(6) Miscellaneous.

The Microscope as an Aid to Physiology.—Canon Wilberforce having stated that the discovery of the circulation of the blood was due, not to Harvey, but “by means of putting the foot of a frog under the lens of a powerful Microscope,” a writer in the ‘Times’* points out the indubitable claim of Harvey; at the same time he acknowledges that one link in the chain was wanting.

“Harvey knew that the blood found some channel by which it passed from the terminations of the arteries into the commencement of the veins, but he could not discover what that channel was. He conjectured that the blood percolated through the tissues, like water through earth; and at that time there was no Microscope in existence capable of showing either a capillary vessel or a stream of blood-corpuscles. Harvey's discovery was completed by Leeuwenhoek, in the second half of the century, by the aid of a Microscope which he made for himself in 1654, and which rendered visible, for the first time, the vessels and the blood-corpuscles in the web of a frog's foot. Canon Wilberforce is therefore entirely wrong in his statement of what he calls a fact; and, if his fact were as he puts it, he would still be entirely wrong in his inference. If Harvey himself had seen a blood-stream in a capillary vessel, the sight would not have taught him the course of the circulation. The way in which blood passes from an artery to a vein through a capillary does not throw any light upon the nature and direction of its general circuits—first through the body, and secondly through the lungs, nor upon the function of the heart, by which it is propelled. The Microscope placed the keystone upon the arch of Harvey's discovery, but it could never have enabled him to construct the arch itself.”

Twentieth Annual Report of Chief of the Division of Microscopy, U.S.A.†—Mr. T. Taylor reports:—“The work done during the past year relates in a great measure to the microscopical investigation of food adulterations, food-fats and oils, textile fibres, and edible and poisonous mushrooms. In relation to fibre investigation, I have had constructed, with your permission, a new machine of my invention for determining

* Oct. 29th, 1892.

† Report of the Microscopist for 1891. pp. 405-6.

the general value and tensile strength of farmers' binder-twine, and for other purposes connected with farming interests. In these tests I have been courteously assisted by the officer in charge of the Bureau of Equipment of the Boston Navy Yard, and also by Mr. E. B. Balch, Superintendent of the National Cordage Company, New York City. This machine is now in good working order. A number of experiments have been made with it, and the results of the preliminary trials are herewith furnished. It may be well to state here that this machine has no relation to another machine invented by me and illustrated herein, designed solely for testing and comparing the relative strengths of fibres and of threads. There is also furnished in this report an interesting statement of preliminary tests, made with this machine, of four samples of foreign flax, showing their relative strength as compared with their relative cost per ton. These samples of flax were received from Mr. J. M. Anderson, Belfast, Ireland.

During the past year I have also devoted considerable time to investigating and reporting upon wool fibres, and have testified officially in the United States courts, for the Secretary of the Treasury, in cases where such examinations were pertinent to a question of dutiable merchandise. Valuable samples of foreign and native wools have been added to the collection in this division through the courtesy of Mr. E. A. Greene, Philadelphia, Pa.; also of Mr. John Consalus, Troy, N. Y., and others.

It may also be proper for me to mention that I have in progress the preparation of a large collection of models representing, by casts taken from nature, the edible and poisonous mushrooms of the United States, in groupings and otherwise, illustrating their manner of growth, development, colouring, and, as far as possible, their diversity of habitat. In this line of work enough has already been done to shape roughly an exhibit for the World's Columbian Exposition, which exhibit, it is desirable, should be as comprehensive and perfect as the one in the Museum at Nice, France, which shows the mushrooms prepared in plaster, life-size, and coloured after nature. In this way the public is enabled readily to compare one kind of mushroom with another, and to study them in all their stages of growth.

With the approval and co-operation of the Assistant-Secretary, I have, as already said, commenced my preparations for such an exhibit, which will be made as complete as the means placed at my disposal will permit."

B. Technique.*

Weichselbaum's Pathological Histology.†—Dr. A. Weichselbaum's work on pathological histology has special reference to methods of research, though there is a considerable amount of descriptive letterpress

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Leipzig and Vienna, 1892. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xii. (1892) p. 255.

and of illustrations. For a first edition the illustrations are unusually numerous, for there are 221 of these, partly wood-engravings and partly zincographs, some being coloured. There are, as well, eight lithographic and photographic plates.

Preservation of Teleostean Ova.*—Mr. Walter E. Collinge states that between October 1891 and July 1892, upwards of 80,000 ova have been examined at the St. Andrews Marine Zoological Laboratory, comprising some thirty known and four or five unknown species. He has made numerous experiments with various preservatives on a large number of these, and gives an account of the results obtained.

Killing.—The most satisfactory results were obtained by adding to a vessel containing the ova, with about an ounce of sea-water, three or four drops of a saturated solution of picric acid, to which had been added 5 per cent. of hydrochloric acid. In this diluted solution they were allowed to remain for not longer than three minutes, during which time they were kept in motion by a pipette. When the ova remained for longer than the time stated, or when the solution was too strong, the yolk was generally ruptured, and considerable wrinkling took place in the zona radiata. In other cases the yolk became considerably contracted. Like results ensued if they were not well washed in fresh water before being transferred to the preservative fluid. After washing in dilute alcohol $12\frac{1}{2}$ –25 per cent., a slight opacity followed. If killed in a saturated solution of 6 parts corrosive sublimate and 3 parts of glacial acetic acid they were also opaque when transferred to any of the following fluids.

Preservatives.—Some dozen or so of picric mixtures were tried, of which the following are the principal:—

(1) In equal parts of a saturated solution of picric acid and 50 per cent. alcohol, ova of *Trigla gurnardus* shrank $\cdot 1524$ mm.; the yolk was contracted and opaque; the oil-globule scarcely visible. In *Pleuronectes platessa* the shrinkage was slightly less,† being $\cdot 1447$ mm.

(2) Saturated solution of picric acid, 1 part; glycerin, 1 part; 60 per cent. alcohol, 2 parts. *Motella mustella* shrank $\cdot 1524$ mm.; the oil-globule was fairly distinct.

(3) Saturated solution of picric acid, 2 parts; alcohol, 1 part. Results very similar to method 1. Shrinkage fully $\cdot 1524$ mm.; oil-globule poor and embryo indistinct.

(4) Saturated solution picric acid, 2 parts; 50 per cent. alcohol, 4 parts; 2 per cent. acetic acid, 1 part. *Motella mustella* and *Trigla gurnardus*; oil-globule and embryo indistinct; zona strongly wrinkled.

(5) Equal parts of saturated solution picric acid, alcohol, and two per cent. acetic acid. The following ova were preserved in this fluid, of which the average shrinkage is given. The oil-globule, where present, was remarkably clear. Embryos very distinct. Ova previously prepared in other fluids, in which the oil-globule was scarcely or not at all visible, speedily came to view when allowed to remain in this fluid for five to twenty minutes.

* Ann. and Mag. Nat. Hist., x. (1892) pp. 228-30.

† The average in all cases is given.

Species.	Average Shrinkage. mm.
<i>Trigla gurnardus</i>	·1447
<i>Gadus morrhua</i>	·1295
„ <i>æglefinus</i>	·1295
„ <i>minutus</i>	·1143
<i>Motella mustella</i>	·990
<i>Brosmius brosme</i>	·1371
<i>Hippoglossus limandoides</i>	·1524
<i>Rhombus lævis</i>	·1371
<i>Arnoglossus laterna</i>	·1447
<i>Pleuronectes platessa</i>	·914
<i>Clupea sprattus</i>	·1143

This was certainly the best of the picric solutions.

(6) Alcohol, 4 parts; 2 per cent. acetic acid, 4 parts; spirits of camphor, 1 part. The results here were very similar to the preceding fluid, but the embryos were not so distinct, owing to the slight opacity of the eggs; on the other hand, the shrinkage was very little. There are many objections to a picric solution which are here met. For general work, or for preserving large collections of ova, this is undoubtedly the best preservative I have used.

Species.	Average Shrinkage. mm.
<i>Trigla gurnardus</i>	·1371
<i>Gadus morrhua</i>	·1295
„ <i>æglefinus</i>	·1295
„ <i>minutus</i>	·1143
<i>Motella mustella</i>	·914
<i>Brosmius brosme</i>	·1143
<i>Hippoglossus limandoides</i>	·1219
<i>Rhombus lævis</i>	·1143
<i>Arnoglossus laterna</i>	·1219
<i>Pleuronectes platessa</i>	·914
<i>Clupea sprattus</i>	·990

(7) Various mixtures of Kleinenberg's micro-sulphuric acid were tried, but the results in all cases were unsatisfactory.

(8) Very satisfactory results were obtained with 50 per cent. alcohol. The shrinkage was small, the oil-globule, however, was indistinct, and the dense opacity is a disadvantage.

(9) Perenyi's fluid stained the eggs a very dark violet. Diluted with 8 parts of 50 per cent. alcohol, very satisfactory results were obtained. The shrinkage averaged ·1371 mm., and the embryo in all the species experimented with showed well.

When ova were not permanently required they were allowed to remain in a 2 per cent. solution of acetic acid, or 4 parts of the same to 2 parts alcohol, and 1 part Perenyi's fluid; both mixtures gave good results. When the embryos were well advanced, they were allowed to remain in the former medium until considerable distention took place—about one hour or less. No effect was noticed upon the embryo until four or five hours.

It will be seen that the most satisfactory results were obtained by killing in picro-hydrochloric acid, and preserving in method 6.

Injection of a Mammal previous to Section-cutting.*—Mr. H. Meller in giving a demonstration of his method, chose a rabbit and killed it by an injection of potassium cyanide into the mouth. "The apparatus and injecting mass being ready, immediately the animal was dead the thorax was opened and the apex of the heart cut off, so as to lay open the right and left ventricles; through the left ventricle a glass cannula was inserted into the aorta and fastened by a ligature tied round this vessel. To the glass cannula an ordinary indiarubber enema was attached, and by this means a continual stream of warm normal saline solution was driven through the vascular system, the blood and saline solution escaping by the right ventricle; as soon as this ran out clear, an ordinary glass syringe, charged with a gelatin mass coloured blue, was substituted for the enema. As soon as the injection began to pass out of the right ventricle a broad ligature was tied tight round the heart, just above the cut end, thereby preventing any more escape of fluid by the right ventricle. The cannula was still retained in the aorta, but the syringe being changed for another containing a gelatin mass coloured red, and not quite so fine as the preceding, this was injected into the arterial system so as to drive the first injection as completely as possible into the veins. During the injection everything was kept under warm salt solution, and when the operation was completed the animal was laid aside for one or two hours to allow the mass to solidify. The demonstrator then explained that at the completion of this time the parts could be prepared for section-cutting, or the animal preserved in 90 per cent. spirit or other preservative. The following are the formulæ for the various solutions used during the demonstration:—Normal saline solution: salt 7.5 grm., water 1000 ccm. Gelatin mass: soak gelatin in water till soft, then melt over water-bath. Red injection: gelatin mass mixed with carmine dissolved in ammonia. Blue injection: gelatin mass mixed with freshly precipitated Prussian blue."

(1) Collecting Objects, including Culture Processes.

Bacteria-fishing Apparatus.†—Dr. Schrank fishes out a specimen from a particular colony for inoculation purposes by means of a needle fitted to a metal case, like an objective, in which the needle is substituted for the lens. With a low power the particular colony is focused at the intersection of cross-threads, and then the lens replaced by the needle, which is lowered down until it reaches the colony. The colony is again observed in order to make sure if the needle has touched it.

Influence of Filtration on Liquids containing Microbic Products.‡—M. Arloing has made some experiments to ascertain what effect earthenware filters have on the composition of fluids containing microbial secretions. The liquid used was the juice of beetroot, after it had been fermented in silos. This fluid was passed through new Chamberland filters, and it was found that a considerable percentage of proteid

* Journ. Brit. Dental Assoc., xiii. (1892) pp. 581-2.

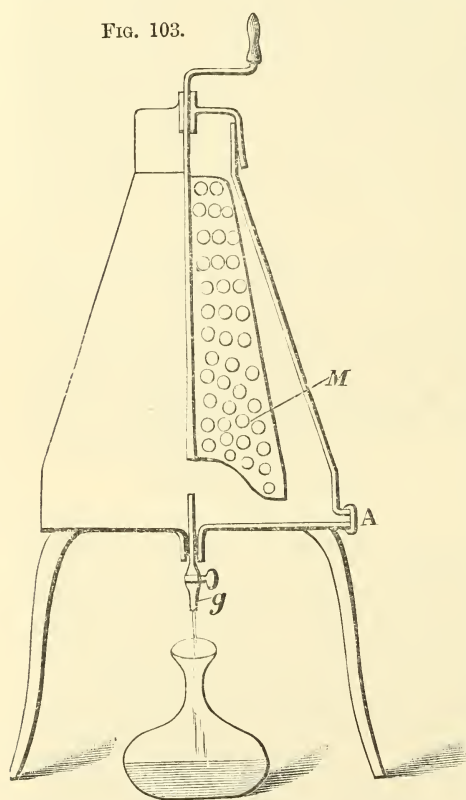
† Zeitschr. d. Allgem. Oesterr. Apothekervereines, 1892, No. 14. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 312.

‡ Comptes Rendus, cxiv. (1892) pp. 1455-7.

and hydrocarbonaceous matter was retained. This retaining power became diminished by use, and also after sterilization of the bougies, and in all cases the toxicity of the filtrate was lowered. Hence the author considers that mineral filters have a distinct hygienic value, but are not sufficiently accurate for scientific purposes.

Permeability of the Chamberland Filter to Bacteria.*—Dr. E. von Freudenreich finds that the Pasteur-Chamberland filtering apparatus will produce germ-free water for at least eight successive days, and that therefore it may be used for household and laboratory purposes provided that it is sterilized every week, and that the temperature of the water does not exceed certain limits (15° – 18°).

Procedure for Obtaining Germ-free Water.†—Drs. V. and A. Babes describe an apparatus for obtaining germ-free water; the vessel itself is



of zinc or glass, having the shape of an Erlenmeyer's flask, and capable of holding 20–40 litres (fig. 103). At the bottom is a pipe with stop-cock for letting off the water, and at the side an aperture, closed by a screw-tap, for cleansing purposes. The vessel having been filled with water, 3–6 grms. of powdered alum are put in, and then stirred up with a flat perforated piece of wood, or by means of a perforated mixer turned by a handle. When thoroughly stirred up the mixer is removed and the vessel covered with a cap. In 18–20 hours the water is drawn off by the tap at the bottom. It is advisable to let the first half-litre run off. The principle on which the apparatus and procedure are founded is that of sedimentation and decantation, and though alum acts very well other substances may be used, such as sulphate of iron or chalk. A similar result was obtained by currents of air, but the details are not given. The authors think that the results of their methods

are very encouraging and infinitely superior to any of the filtration methods, all of which are condemned as being worse than useless. The

* *Centralbl. f. Bakteriol. u. Parasitenk.*, xii. (1892) pp. 240–7 (1 fig.).

† *Tom. cit.*, pp. 132–8 (1 fig.).

main objection to filters is, that after having been used for a few days the filtered water contains more germs than the unfiltered. Of course all the results were tested bacteriologically.

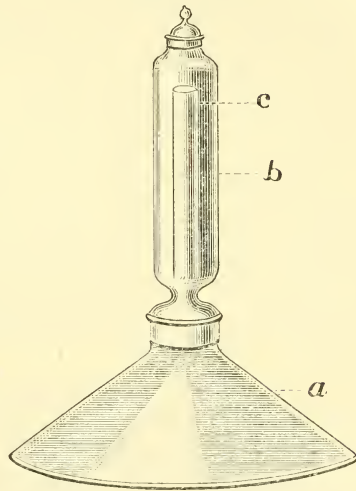
Trambusti's Culture Apparatus.—We give a figure of this apparatus (fig. 104), a description of which appeared in the last number of the Journal (p. 691).

Keeping the Inoculation Wire.*—Dr. H. C. Plaut suggests that medical men desirous of obtaining cultivations of disease germs can keep the inoculating platinum wire and glass rod, previously sterilized of course, within the test-tube containing the cultivation medium, the test-tube being plugged with cotton-wool and covered with a caoutchouc cap.

Method for Cultivating Anaerobic Bacteria.†—Herr Hesse cultivates anaerobic bacteria in test-tubes on solid media in the following way:—In a test-tube already filled with a solid medium, cotton-wool is loosely pushed in for a distance of some cm., the open end of the tube is then immersed under mercury, and hydrogen introduced into the tube. The tube is then withdrawn, the cotton-wool removed, the medium inoculated, and then the open end again immersed under the mercury, and hydrogen again introduced. For liquid media, or those which may become so, and for plate cultivations, a bell-jar is used.

Apparatus for Cultivating Anaerobic Bacteria.‡—Dr. A. H. C. van Senus uses a very simple and convenient apparatus for cultivating anaerobic bacteria. In a glass tube, the diameter of which is about 6 mm., a U-shaped bend is made, and one end drawn out to a point. The narrow end having been covered, and the wide end plugged with cotton, the apparatus is sterilized. To fill the tube the narrow end is inserted in gelatin or agar, previously inoculated, and the medium sucked in through the broad end. When sufficient has reached the U-shaped bend the narrow end is sealed up. In order to obtain a colony for inoculation purposes the tube is carefully cleaned with H_2SO_4 and sterilized water, and then having been notched with a sterilized file, the piece on which the colony desired is situated, is removed. The disadvantage of the method is that it does not afford any chance for microscopical observations, although a hand lens is available. But by a modification the device may be adapted to plate cultivations, by simply blowing a bulb in a tube with diameter of about

FIG. 104.



* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 203.

† Zeitschr. f. Hygiene, xi. No. 2. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 173.

‡ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 144-5.

6 mm. The bulb should then be flattened out so that its thin sides are not more than 2-3 mm. apart. This apparatus is sterilized and used in much the same way as the former, and its only disadvantage is that it must be broken in order to isolate a colony.

Capsule for Cultivating Anaerobes.*—Dr. L. Kamen describes a neat little contrivance for cultivating micro-organisms, which he has used very successfully in experiments with tetanus. It consists of a flat circular glass capsule, the side of which forms a broadish edge, on which the cover, of equal diameter, rests. In the edge are cut out, on opposite sides, two narrow grooves with a slope towards the bottom of the capsule. In the cover are two small holes.

The apparatus is easily manipulated. After having been filled with some cultivation medium in the usual manner, the margin of the cover and the flat edge of the capsule are smeared with vaselin, and the two adjusted so that the holes in the cover are over the oblique grooves. The apparatus is then filled with gas (H_2 ; CO_2) which replaces the air by driving it out at the opposite opening. When filled the cover is just slipped aside so that a hermetically closed cavity is immediately made.

Three illustrations are given, one showing the upper surface, and the two others sections of different portions.

Cultivating Gonococcus.†—According to Herr E. Wertheim, *Gonococcus* can be easily cultivated if human blood serum be used. The serum is solidified by adding sterilized gelose to it. From these cultivations typical gonorrhœa was excited in the human urethra (five cases). The gonococcus retains its virulence for some weeks provided it be protected against desiccation. It thrives better in absence than in presence of oxygen.

Inoculation experiments on animals showed that it was capable of exciting peritonitis, although different kinds of animals evinced unequal degrees of susceptibility.

Sig. A. Risso‡ succeeded in cultivating gonococci, from a recent case of gonorrhœa, on placenta blood serum, both with and without the addition of agar or gelatin. Inoculations with pure cultivations in the anterior chamber of the eye of a rabbit gave positive results.

Pure Cultivations of Tubercle Bacilli from the Human Corpse.§—Dr. Wünschheim states that he succeeded in obtaining pure cultivations of tubercle bacilli by using some pia mater from a case of acute tubercular meningitis. The cultivation medium was blood-serum, and three out of five were successful.

Isolating a Rennet Ferment from Bacteria-cultures.||—Prof. H. W. Conn has succeeded in separating the rennet ferment from the proteolytic

* Centralbl. f. Bakteriologie u. Parasitenk., xii. (1892) pp. 296-8 (3 figs.).

† Prager Med. Wochenschrift, 1891, Nos. 23-4. See Annales de Micrographie, iv. (1892) pp. 359-60.

‡ La Riforma Medica, 1892, No. 118. See Centralbl. f. Bakteriologie u. Parasitenk., xii. (1892) p. 205.

§ Prager Med. Wochenschr., 1892, No. 25. See Centralbl. f. Bakteriologie u. Parasitenk., xii. (1892) p. 205.

|| Centralbl. f. Bakteriologie u. Parasitenk., xii. (1892) pp. 223-7.

enzyme allied to trypsin, both of which are found in milk after the action of certain kinds of bacteria, in general those having a liquefying action on gelatin. Sterilized milk is inoculated with the bacterium, which is allowed to grow for 7-10 days after coagulation has occurred. The milk is then carefully shaken up with distilled water, and next passed through a porcelain filter. The clean filtrate contains all the soluble ferments. It is frequently colourless, but is often of an amber hue, or even brownish. From this material the soluble ferments may be precipitated by alcohol, collected and dried, the dried precipitate having the property of coagulating milk and peptonizing gelatin. The rennet is separated from the pepsin by acidulating the filtrate with 0.1 per cent. of sulphuric acid, and then adding common salt in excess. When the fluid becomes saturated with salt a snowy scum forms on the surface. This is nearly pure rennet ferment. The scum is then removed and dried. The snow-white powder is rennet mixed with salt, and possibly some other impurities.

The rennet ferment seems to be more quickly developed at moderately low (20°) temperatures than at higher ones (35°), which are more favourable to the pepsin ferment.

(2) Preparing Objects.

Investigation of Origin of Vascular Germs in the Chick.*—M. L. Vialleton opened the eggs in water to which a small quantity of salt solution had been added, and which had been heated to 35°; the blastoderm was rapidly cut out and placed on a glass plate; it was then treated with a 1 per cent. solution of silver nitrate, washed with distilled water, and put (in darkness) in 70 per cent. alcohol for from six to twelve hours. On being removed from the alcohol it was put in an alcoholic solution of borax-carmin, in which it remained till it was sufficiently stained; it was then washed with 70 per cent. alcohol slightly acidulated with hydrochloric acid, dehydrated completely in 90 per cent. and absolute alcohol, and mounted in dammar. Owing to the reduction of the nitrate of silver, the boundaries of the epithelial cells were well marked, while the borax-carmin stained the nuclei in such a way that a fine preparation was obtained, in which a number of interesting histological details could be made out. The only fault of this method of preparation is that the reduction of the nitrate of silver sometimes goes too far, and sometimes the ectoderm becomes folded.

Spermatogenesis of Gryllotalpa.†—Dr. O. vom Rath obtained best results with Flemming's chrom-osmo-acetic acid, "Hermann's fluid," and a mixture of picr-osmo-acetic acids. As stains, the most successful were alum-cochenil (24 hours in warm temperature), and safranin-gentian-orange.

Examination of Gills of Palæmonetes varians.‡—Mr. E. J. Allen found that the gills of this Crustacean were somewhat difficult to preserve; the use of sublimate and alcohol failed to give satisfactory results. With strong Flemming's solution he was able to obtain preparations

* Anat. Anzeig., vii. (1892) pp. 624 and 5.

† Arch. f. Mikr. Anat., xl. (1892) pp. 102-32 (1 pl.).

‡ Quart. Journ. Micr. Sci., xxxiv. (1892) pp. 75 and 6.

which showed both cell-outlines and protoplasmic structure in an excellent state of preservation. The objects must remain in the solution for from three to fourteen hours, according to the degree of softness of the chitin. After hardening in alcohol, the specimens were stained with Delafield's hæmatoxylin, and were removed from Flemming's solution to water, and after a few minutes transferred to crude pyroligneous acid, where they remained for nearly twenty-four hours; by this last process (von Mährenthal's method), the osmic acid is reduced in the tissue, and no further staining is required. After dehydration, the objects were sunk in chloroform, and then placed for several hours on the water-bath in a mixture of chloroform and paraffin, after which they were imbedded in paraffin, and cut in the usual way.

Examination of Nervous System of *Ascaris megaloccephala*.*—Herr R. Hesse made transverse and longitudinal sections of this Nematode. The material, which was fixed by sublimate solution, water at 60°, chrom-osmic-acetic acid, 1/2 per cent. osmic acid, picrosulphuric acid, and 96 per cent. alcohol, was found to be useless, as the nerves crumpled up greatly. By chance in one sublimate and one water preparation a part of the nerve was not crumpled. In the rest, the ganglion-cells were alone made clear by this method. Others which were placed fresh, for a day, in 1/2 or 1 per cent. solutions of chromic acid, and for a week in chromates, gave poor results when imbedded in paraffin, but better when placed in celloidin. The best results were got with specimens that had hardened for a long time in alcohol. Grenacher's borax-carminé was used for staining.

Preparation of Embryos of *Strongylus paradoxus*.†—Herr B. Wandollech observed the development of living ova in weak salt solutions at a temperature of 30°; to prevent evaporation the cover-glass was surrounded on three sides by wax, while the fourth remained open to allow of the addition of fluid. To make preparations of the complete egg, a specimen of the worm was placed without any fluid on a very thin slide, and cut through in the middle; the uterus escaped with the fluid of the cœlom. The slide was next flooded with the fixing fluid heated up to 70°. The albumen coagulated, and while the embryos were preserved they were at the same time firmly fixed to the slide, and could be treated like sections attached by albumen. Borax-carminé was used for staining, and it was found necessary to leave the eggs in it for some time. In order that the cell-boundaries might be made distinct, Herr Wandollech made use of a method suggested to him by Prof. F. E. Schulze. On removing the preparations from absolute alcohol, he placed them in picric acid dissolved in xylol; the objection to this method is that it requires much practice and patience.

Examination of *Strongylus convolutus*.‡—Dr. H. Stadelmann was, owing to the transparency of this worm, able to make *in toto* preparations of it; these were put in glycerin, and not in Canada balsam, as in the latter reagent specimens become in time quite opaque; this was not owing to insufficient removal of the water, as animals which had been

* Zeitschr. f. Wiss. Zool., xlv. (1892) pp. 549 and 50.

† Arch. f. Naturg., lviii. (1892) pp. 127-9.

‡ Tom. cit., pp. 152 and 3.

for months in absolute alcohol, renewed almost daily, exhibited the same phenomenon. Cold bichloride of mercury was used as a fixing reagent; Lang's solution generally destroyed the cuticle. Other fixing materials are not suitable for Nematodes, as they affect the subsequent staining.

To avoid crumpling, the hardening was effected in Schulze's dialyser, after which the pieces were left for some time in absolute alcohol. They were then treated, not with xylol, which causes crumpling, but with chloroform. This was evaporated in an oven, and paraffin was continually added; when this had set, sections of $3\ \mu$ thickness were cut. Sections were stained with borax-carmin or hæmatoxylin; gold-chloride was used to make the cell-boundaries more distinct. In order to follow out the finest details of the nervous system chrom-osmic acetic acid was used, followed by acetic, the pieces being about six hours in the former, and twenty-four in the latter fluid.

Investigation of Ctenophora.*—Dr. P. Samassa succeeded, notwithstanding the statements of Chun and Hertwig, in making satisfactory sections of Ctenophores. He effected this by the celloidin-paraffin method which he modified as follows; the object was removed from absolute into a mixture of equal parts of ether and absolute; ordinary celloidin was cut up into small pieces, and dried in the oven so as to completely remove all the water. Every day a piece was added to the alcohol and ether mixture in which the object was, so that after ten days the solution was glairy. As the long period of remaining in the solution is not in the least harmful to the object, a slow increase in the amount of celloidin is much to be recommended, as the danger of curling up is thus avoided as far as possible.

Preparation of Budding Hydroid Polyps.†—The specimens studied by Herr A. Lang, which were sent him from Naples, were preserved in 70 per cent. sublimate alcohol, those from Genoa were partly in absolute, and were partly killed by hot sublimate and preserved in 90 per cent. alcohol. The sections were stained with picro-carmin (after Ranvier), alum-cochineal and hæmatoxylin; double staining was effected by picro-carmin (*in toto*) and subsequently by hæmatoxylin and Lyon's blue. Alum-cochineal stained the nuclei well. The *Hydræ* were preserved with hot watery or alcoholic sublimate solution, and partly with Rath's mixture of picric, osmic, and acetic acids.

Von Koch's Petrifying Method.‡—Dr. C. Röse discusses the method of petrification which von Koch used in studying silicious sponges, corals, and the like, and points out that L. A. Weil, in using it for the study of teeth, omitted to "steam" very slowly, and thus obtained artificial results. For "Weil's sheath" is certainly an artificial product, and can be produced by a misuse of Koch's ingenious method.

Observation and Vivisection of Infusorians in Gelatin.§—Herr P. Jensen finds, as Prof. Stahl suggested, that a gelatin solution is most useful for studying infusorians and the like. Their movements

* Arch. f. Mikr. Anat., xl. (1892) p. 158.

† Zeitschr. f. Wiss. Zool., xlv. (1892) pp. 366 and 7.

‡ Anat. Anzeig., vii. (1892) pp. 512-9.

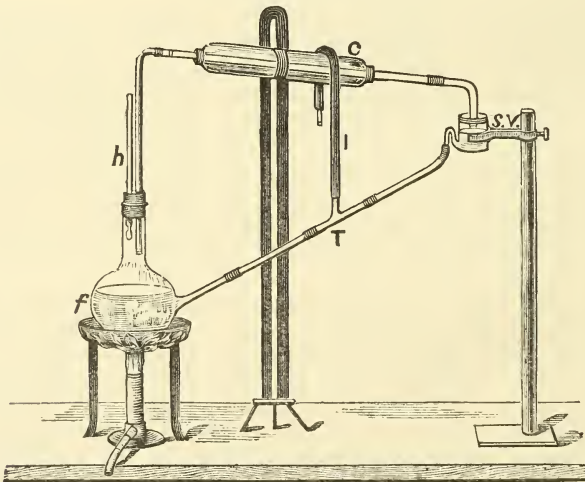
§ Biol. Centralbl., xii. (1892) pp. 556-60.

are inhibited while their life is preserved. Three grams of white gelatin are dissolved by heating in 100 ccm. of water; the result is a stiff jelly at the temperature of the room. In this, about 3 per cent. gelatin solution, which may be diluted if desired, the movements of *Paramæcium* and *Urostyla* are prevented, but the cilia and the contractile vacuoles remain active for hours. For observing the movements a solution of 1·5 per cent. is most useful; for vivisection experiments ·8-1 per cent.

(3) Cutting, including Imbedding and Microtomes.

Hard Section Cutting and Mounting* — Mr. J. W. Dunkerley recommends the following process, which is specially adapted for dealing with large specimens, such as horse's teeth, as well as smaller ones. "Sections are cut off the tooth by means of a thin copper disc, fitted in the ordinary manner on to a dental lathe, and revolving in a tin trough which contains water and fine corundum powder. This thin disc is now replaced by a thick one, with the same trough and contents; the sides of this disc are used as a lapidary stone to grind thinner these sections, one side of which is next polished on a soft stone (Water of Ayr) under running water, this surface being afterwards secured to a glass slip by thick Canada balsam. The grinding of the section on the thick copper disc is now proceeded with until the section is thin enough to see the structure; then proceed to polish this surface on the Water of Ayr stone until all details are seen under the Microscope, when after careful washing the section is mounted."

FIG. 105.



Rapid Method of Dehydrating Tissues before Infiltrating with Paraffin.†—Mr. G. L. Cheatele describes a modification of Soxhlet's

* Journ. Brit. Dental Assoc., xiii. (1892) p. 581.

† Journ. Pathol. and Bacteriol., i. (1892) pp. 253-5 (1 fig.).

extraction apparatus which he has devised for dehydrating pieces of tissue (fig. 105). It consists of a flask capable of holding 25–30 oz. of fluid; from the neck of the flask proceeds a tube through which spirit vapour at first, and afterwards liquid alcohol passes to a vessel in which the piece of tissue to be dehydrated is placed. From near the bottom of the flask proceeds another tube to the dehydrating vessel, and the latter is joined to the former by a siphon. Hence, if the flask be filled with alcohol above the level of the side tube and heated in the usual way, the pure spirit will pass along the upper tube to the siphon-vessel containing the tissue to be dehydrated, and then from this vessel back through the siphon to the flask. Hence this continuous distillation means rapid dehydration. The water is absorbed by putting a handful of quicklime in the flask with the spirit.

The only other detail which may be mentioned is that from the middle of the lower or side tube which connects the flask with the siphon-vessel is a tube coming off at right angles. This seems to act chiefly as a safety valve. All the parts are connected with rubber tubing, and fixed in the usual way.

Taken altogether, the apparatus seems to be very ingenious, and worth a trial, as its action is continuous and automatic, and the waste quite a minimum.

Imbedding Vegetable Objects in Celloidin.*—According to Herr W. Busse it takes 3–4 weeks to properly prepare an object by the celloidin process. The object should be perfectly dehydrated and free from air, and be gradually impregnated with celloidin by successive immersion in solutions of increasing thickness. At least three different solutions are required. The next step is to imbed the object in thick solution in paper capsules. These are then placed in alcohol for twenty-four hours, by which time the celloidin mass is ready for sectioning. The author deals with sectioning and the after treatment of the sections, and shows how to remove the celloidin by a modification of Chauveaud's procedure.

Paraffin Infiltration by Exhaustion.†—Mr. A. Pringle advocates the infiltration of tissues with paraffin by means of exhaustion on account of celerity; certain and complete infiltration; certain removal of the solvent; absence of distortion of the tissue elements; avoidance of overheating, and economy.

The object may be fixed by immersing in saturated solution of $HgCl_2$ for about 12 hours, and then washing in running water for a like time. After this it is passed through 30, 50, and 70 per cent. alcohols successively for 24 hours apiece. The pieces are preserved till wanted in 70 per cent. alcohol. Or the objects may be fixed and hardened in Müller's fluid followed by the alcohols as above. When required the pieces are transferred from 70 per cent. alcohol to pure methylated spirit, and absolute alcohol (twice) each for 24 hours. Chloroform is then put under the spirit by means of a pipette or syringe, and left for 24 hours. The mixture is replaced by

* *Zeitschr. f. Wiss. Mikr.*, viii. (1892) pp. 462–75. See *Bot. Centralbl.*, li. (1892) p. 292.

† *Journ. Pathol. and Bacteriol.*, i. (1892) pp. 117–9.

pure methylated chloroform, and the containing vessel left loosely stoppered on the paraffin stove till all traces of alcohol have vaporized. Then the tissue is placed in melted paraffin, and as soon as it is warmed through, it is placed under an air-pump. The plate of the air-pump is smeared with glycerin or lard; over this is laid a sheet of indiarubber, and this also treated with glycerin or lard.

As soon as the air is exhausted from the receiver bubbles begin to rise, and as long as they do the pumping may be continued, though it is well, after a little pumping, to let the air into the receiver at least once. This is done by having a tap between the air inlet and the plate. The paraffin must be kept melted the whole time. If the paraffin solvent has been chloroform, the whole process takes about fifteen minutes, but if the preparation have been cleared with benzole and cedar oil, the time required is a little longer.

The pieces of tissue dealt with are supposed to measure $1 \times 1\frac{1}{2}$ in. by $\frac{1}{4}$ in. thick. For further details and other hints the original must be consulted.

Beck's Double Slide Microtome.—This microtome introduces a new feature in section-cutting which Messrs. Beck consider of some importance. The single slide microtome of the usual type, when used with the long diagonal knife, possesses this disadvantage, that the razor being supported at one end only is liable to have considerable spring or give at its further end, thus decreasing its stability, and rendering it more difficult to cut the finest sections.

The double slide microtome has a strong frame to carry the knife, which runs on two parallel circular bars of steel. The knife is clamped upon both sides of this frame, the object to be cut being between. The

FIG. 106.

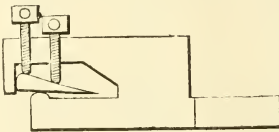
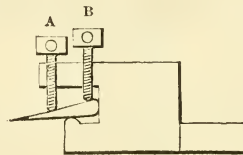


FIG. 107.



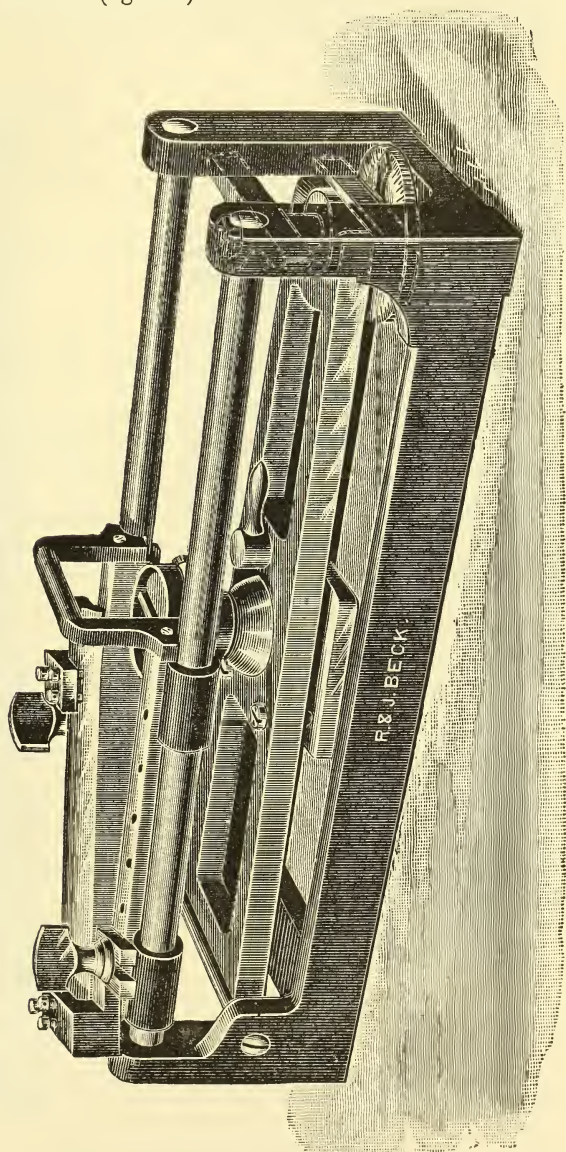
knife, which has a blade 7 in. long, is thus supported at both ends, and the whole extent of the blade can be used. The position of the razor can be varied at will; the clamps can be placed at any position on the frame, so that the knife can be placed at right angles to the direction of cut, or in any diagonal position.

The clamps are on a new principle. The blade of the knife rests upon a ledge on the lower surface of the clamp, and is held in position by three screws at the top, two at A (fig. 107), in front of the ledge, and one at B, behind the ledge; thus by altering the relative position of these screws, the angle of the blade may be varied; the under portion of the knife, which is flat, may be placed so as to be quite horizontal, or may have a slight inclination. In addition to this, these clamps are capable of carrying almost any razor.

The object-holder is carried in a ball clamped in a long plate, which

plate is pivoted at one end of the microtome and raised by a micrometer screw at the other (fig. 108).

FIG. 108.



The ball when unclamped gives a motion for moving an object in all directions till it is in the required position. The milled head which raises the object is divided into 100 divisions, and has an index, each

division of the scale raising the object $\frac{1}{5000}$ in. ($\cdot 0002$). It is obvious that the section is slightly wedge-shaped, but the amount is so extremely trifling, that expert section-cutters have informed the makers that they consider it immaterial.

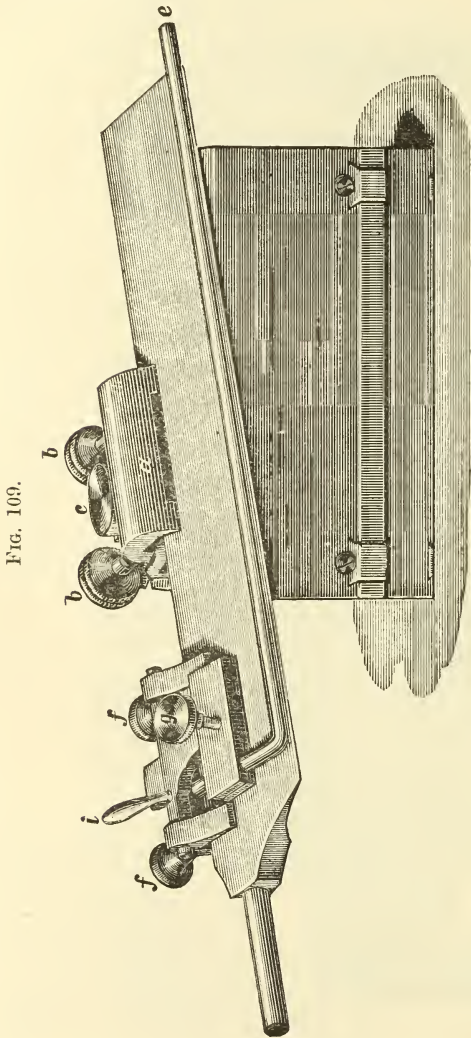


FIG. 109.



FIG. 110.

Mayer's Section-stretcher.—The section-stretcher shown in fig. 109 can in this new form be used on each side of the knife, and is easily fitted on the back. The long rod *e* is adjusted, partly by hand and partly by means of the screws *f*, so that it is parallel to the knife-blade

and projects half beyond it; it is then lowered by the screw *g* until almost in contact with the blade.

Thanhoffer Knife.—Fig. 110 represents a knife for Microscope sections, which is provided with a water-spray.

Preserving Fluids.*—Dr. F. Krasser recommends, as a highly anti-septic preserving fluid for vegetable preparations, a mixture of 1 vol. acetic acid, 3 vols. glycerin, and 10 vols. of an about 50 per cent. solution of sodium chloride. It has also the property, in many cases, of preserving the natural colour of the section. The author also refers to the property of a 1 per cent. alcoholic solution of salicyl-aldehyde of fixing the colour of pigments, as, e. g. that of the chromatophores of *Solanum Lycopersicum*.

(4) Staining and Injecting.

Methods of Staining Medullated Nerve-fibres.—The following is an account of the remarks made by Dr. Beevor at the meeting in October. Dr. C. E. Beevor, after stating that the title of his paper was not quite correct, as not only the fibres but the cells also were stained, briefly described the methods of work with the following stains:—

Weigert's Acid Fuchsin Method.—The material is hardened in a 3 per cent. solution of potassium bichromate for six weeks, then imbedded in celloidin, cut, and the sections placed in a saturated aqueous solution of acid fuchsin. They are then washed in water, and transferred to absolute alcohol with 1 per cent. of caustic potash until the grey matter is of a lighter colour than the white. The sections are again washed in water before mounting. This method may also be used for staining *in toto*, and afterwards imbedding in paraffin.

Weigert's Hæmatoxylin Method (1884).—The material is hardened for from two to six months in potassium bichromate, imbedded in celloidin, sectioned, and transferred direct for 24 hours into a solution of hæmatoxylin (hæmatoxylin 1 grm., absolute alcohol 10 cm., water 90 cm.). The sections are then washed quickly in water, and passed into the following solution:—Ferricyanide of potash $2\frac{1}{2}$ parts, borax 2 parts, water 100 parts, in which they can be left until no more colour comes out. Afterwards wash in water, dehydrate in absolute alcohol, clear in oil of cloves, and mount in Canada balsam.

The medullated fibres are stained dark blue, and the grey matter and fibrous tissue a pale yellow.

Staining *in toto* with this method is not a success as the hæmatoxylin will not penetrate.

Prof. Weigert recommends the addition of a minute quantity of an alkali such as lithia carbonate to the hæmatoxylin solution, which turns it a dark purple colour.

Weigert's Copper Method (1885).—Weigert puts the imbedded block into a solution of acetate of copper half saturated, and then cuts, stains, and treats with the ferricyanide solution.

Dr. Beevor said that he usually used this method after sectioning, placing the sections in a solution of acetate of copper, washing off the excess in methylated alcohol, then staining and developing.

* SB. K. K. Zool.-Bot. Gesell. Wien, xlii. (1892) p. 56.

By this method the fibres are much blacker and the substance a dark orange.

Pal's Modification of Weigert's Method was brought out about three or four years ago. The hardening process in this method is extended to a longer period, sometimes up to six months. After staining the sections in the hæmatoxylin solution, they are rapidly washed in water, and transferred to a 1/4 per cent. solution of permanganate of potash till there is a differentiation, then into a watery solution of potassium sulphite 1 per cent., oxalic acid 1 per cent.; this bleaches all but the medullated fibres, which appear quite black; carmine can then be used.

Success with this method is harder to obtain than with Weigert's procedure. It does not show the different forms of fibres so well, but is useful on account of the double stain.

Schafer's Improvement of Pal's Method.—The material is hardened from four to six weeks, and, after cutting, the sections are put into Marchi's fluid (1 part of a 1 per cent. solution of osmic acid, and 2 parts of a 3 per cent. solution of potassium bichromate). Then wash quickly in water and stain with the hæmatoxylin solution (hæmatoxylin 1 grm., acetic acid 2 ccm., water 100 ccm.). Develop afterwards as by Pal's method.

This is a very good method for quickening the hardening process, and for sections which have been too long in alcohol after potassium bichromate.

Marchi's Method for Degenerate Medullated Fibres.—Harden several pieces in a 3 per cent. solution of potassium bichromate for a week, then cut a thin slice and put in Marchi's fluid for a week. Imbed in celloidin, section, and develop.

By this method only the degenerate fibres are stained black.

Lewis's Method for Staining Cortical Cells by Anilin Blue-black.—Sections are made from a fresh brain, frozen, stained by .25 aqueous solution for one hour, afterwards washed in water, and developed.

Golgi's Method.—The material is hardened in potassium bichromate, put into a solution of silver nitrate, and then washed in water: The sections are dehydrated in alcohol, and mounted in Canada balsam.

Imbedding for Examining Tissues for Tubercle Bacilli.*—Sig. G. Cirincione dehydrates the material to be sectioned in absolute alcohol and then transfers it for twelve hours to bergamot oil. It is then soaked in melted cacao butter for 24 hours and kept at a temperature of 35° C. Thus impregnated the mass is set by cooling under a stream of water. It is then quite ready for cutting, which in summer should be done immediately. The sections are next transferred to bergamot oil which dissolves out the cacao butter, and then to absolute alcohol, after which they may be stained in the usual manner. The advantages of this method are that micro-organisms contained in the tissues are not exposed to physical or chemical damage during manipulation, that it is expeditious, and that it stains "plasma-cells" quite well.

Method for Making Paraffin Sections from Preparations stained with Ehrlich's Methylene-blue.†—Mr. G. H. Parker, at the suggestion

* *La Riforma Med.*, 1891, p. 253. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xii. (1892) pp. 173-4.

† *Zool. Anzeig.*, xv. (1892) pp. 375-7.

of Prof. F. E. Schulze, has devised a method for making these sections. The elements of the nervous system of a Cray-fish were stained by injecting 1/10 to 1/20 ccm. of a 0·2 per cent. aqueous solution of methylen-blue into the ventral blood-sinus; in about fifteen hours many cells and fibres were stained. Preparations thus made retain their colour for only about an hour, unless they are treated with reagents which precipitate the methylen-blue; the best to use is corrosive sublimate used as a cold, concentrated, aqueous solution. The tissue must now be dehydrated in a solution composed of 1 grm. of corrosive sublimate and 5 ccm. of methylal. It is next put in a mixture composed of two parts xylol, one part pure methylal, and one part of the dehydrating mixture of sublimate and methylal. After a short time in this it is placed in a considerable quantity of xylol for four or five days. After this it may be either mounted in xylol-balsam and studied as a transparent object, or imbedded in paraffin and cut in the usual manner. The sections should be fixed to the slide with Schällibaum's collodion, and not with Mayer's albumen which discharges the colour. Preparations or sections made in this way are serviceable for several weeks.

Staining Sympathetic Nerve-cells.*—Prof. A. Van Gehuchten recommends the following method; the ganglia are to be extracted from animals killed with chloroform and put at once into a mixture of 5 parts of 1 per cent. osmic acid and 20 parts of 3 per cent. bichromate of potash. Leave in the dark for three days; then wash rapidly with distilled water and place in a 0·73 per cent. solution of nitrate of silver. If there is not a slight precipitate add to the silver bath a few drops of the osmio-bichromic solution. Leave the piece in the silver bath in the dark for at least two days. Again wash rapidly with distilled water, and again immerse in the osmio-bichromic solution. After three days and another rapid washing replace in the silver bath for at least two days. Then imbed in celloidin.

Technique for Botanical Investigations.†—Herr J. af Klercker describes a method of preparing vegetable microtome sections without previous fixing or saturating with paraffin. The object is placed at once in solidifying paraffin, and cut with the knife placed very obliquely and moistened with water. For dry herbarium material, articles of commerce, &c., he recommends that, before placing in the paraffin, they should first be immersed in cold or boiling water, ammonia, or dilute potash-ley; very brittle objects may be saturated with glycerin-gelatin. For making permanent preparations of objects containing tannin, the author recommends the following fixing solutions:—(1) Flemming's chrom-osmic acid; (2) a mixture of 1 part Kleinenberg's picrin-sulphuric acid, and 1 part 5 per cent. solution of potassium bichromate; (3) a mixture of 1 part picrin-sulphuric acid and 1 part concentrated solution of cupric sulphate; the second for not more than one day; the third from one to two days. In thick sections the tannin-cells appear brown-red by the first and second, green by the third method.

Staining Cell-nucleus of Pollen-grains.‡—Herr A. Meyer uses for this purpose a substance which he calls chloral-carmin, consisting of

* La Cellule, viii. (1892) p. 87.

† Verhandl. Biol. Ver. Stockholm, iv. See Bot. Centralbl., lii. (1892) p. 56.

‡ Ber. Deutsch. Bot. Gesell., x. (1892) p. 363.

0.5 gm. carmine, 20 ccm. absolute alcohol, and 30 drops of hydrochloric acid, which is heated for thirty minutes in a water-bath, when 25 gm. chloral hydrate are added. This solution, filtered after cooling, stains the nuclei of pollen-grains in ten minutes an intense red. It can be used also for the nuclei of pollen-tubes grown on gelatin, since it liquefies that substance.

Sterilization of Drugs for Hypodermic Use.*—Sig. D. Marinucci has found that many hypodermic solutions, such as freshly prepared 1/2–1 per cent. strychnine sulphate, curara, eserin, atropin sulphate, hydrochlorate of morphine, and 100 per cent. quinine chlorate were examined by bacteriological methods, and found to contain a greater or less (but always considerable) number of living germs which apparently are not all of a harmless nature.

Solutions sterilized by means of heat and non-sterilized solutions were injected into rabbits and white rats, and in some cases frogs and mice.

The experiments showed that the therapeutic value of strychnine, curara, quinine, and eserin were unaffected after sterilization by heat. The action of morphine and atropine was diminished by heat sterilizing and, therefore, the dose should be increased if the solution have been sterilized. Eserin was completely altered. The solutions of eserin and atropin were best sterilized by preparing them with a 1:1000 sublimate solution, by which their therapeutic properties were unaffected. It would be better however to renew the solutions every fourteen days, although they will keep for a long time. The author was unable to hit upon any practical method for sterilizing morphine without damaging its therapeutic action.

New Method for Staining Microscopical Preparations.†—Dr. W. Swiatecki describes a device for staining microscopical preparations, which is said to be both practical and satisfactory. It merely consists in covering the preparation with filter-paper soaked in the staining solution. The procedure is suitable to dried layers of fluid and to sections. It is carried out on a slide in preference to cover-glasses. The filter-paper should be not quite as big as the slide, and to this when applied in one or more layers the staining fluid is dropped on. When it has acted for a sufficient length of time it is washed off, and the layer or section treated in the usual manner, either for decoloration, for counter-staining, or for dehydration.

It is almost unnecessary to remark that when a layer of fluid, e. g. sputum, is made on a slide, the superficial extent of the layer needs several cover-glasses.

Simple Method for Staining Tubercle Bacilli in Sputum.‡—Dr. P. Kaufmann uses boiling water as the decolorizing agent instead of acid, and his method is as follows:—

The sputum is dried on the cover-glass and then fixed in alcohol or over the flame, after which it is stained in the usual manner with phenol-fuchsin. The cover-glass is next waved about in boiling water for 1½ to

* *La Riforma Med.*, 1891, p. 805. See *Centralbl. f. Bakteriol. u. Parasitenk.*, xii. (1892) pp. 282–3.

† *Centralbl. f. Bakteriol. u. Parasitenk.*, xii. (1892) pp. 247–9.

‡ *Tom. cit.*, pp. 142–3.

3 minutes. The preparation may then be contrast stained or examined at once in water, the tubercle bacillus appearing dark-red on a whitish-grey background.

In order that the staining should succeed well, the layer of sputum should be as thin and even as possible.

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- WURTZ—Technique Bactériologique. (Bacteriological Technique.) Paris, 1892, 8vo.

(5) Mounting, including Slides, Preservative Fluids, &c.

Use of a Substitute for Canada Balsam.*—Dr. A. M. Edwards, who has long sought for a substitute for Canada balsam for mounting objects for microscopic use, and has, in fact, employed a hundred different media, rejected them one by one until he got the one which he now describes.

"I use the gum thus, or frankincense, which is the gum or balsam of the *Pinus tæda* L. (loblolly, or old field pine), which is found in Virginia and southward, common. In Florida it is very common, constituting the 'Pine Barrens' of that State. It was described in the 'Dispensary of the United States of America,' sixteenth edition, 1889, by Wood and Bache, and by Wood, Remington, and Sadtler as from the *Pinus Australis* Mich. (*P. palustris* Mill.), and *P. tæda* Linn. It is dissolved in alcohol. A saturated solution is made by adding ordinary alcohol to a large quantity of the gum and set by for a day or so until it is dissolved. The clear solution, which is darker than balsam, is poured off, and three parts acid to one of oil of cinnamon is added to nine [parts of the solution]. This is the solution that is used for mounting. The gum thus is more highly refractive than Canada balsam alone, and when we add to it oil of cinnamon we use liquid of the highest refractive powers that we can use. To use it, we dry the substance, diatoms, or other substance in the cover or slide, and add with a dipper (an iron wire is good) a drop or two of the solution. We then warm it until the alcohol is flown off and bubbles formed are driven off, and the cover is pressed on the glass slide and the whole cooled. The slide is then cleaned with solution of ammonia (I use a weak household ammonia) or carbonate of soda, or borax and water. A ring of asphaltum or gold size can then

* Science Gossip, 1892, p. 236.

be turned around the cover, and the mounting is done. It will be found that the mounting is easy as compared with Canada balsam, for no turpentine is used, and as no sticky residuum is used the cleaning is also easy. I think that those who use it will be pleased with the results, and Canada balsam mounts be sent to the limbo."

The Rev. Father Thompson's High Refractive Medium.*—Mr. E. M. Nelson, who some years back exhibited a beautiful slide of diatoms, mounted in a very dense medium by the Rev. Father Thompson, has now, through the kindness of that gentleman, been able to communicate the recipe of the composition. He still has the same slide in his possession, and, so far as it is possible to judge, it has remained unaltered. He therefore begs to commend Father Thompson's high refractive medium to the especial notice of the Quekett Club as the best thing that has been done in that direction.

"Take flower of sulphur, bromine, and arsenious acid in the proportions of 8, 10, and 12 respectively by weight. Dissolve the sulphur in the bromine with gentle heat in a thinnish test-tube about 6 in. long. Over a small Bunsen jet add small portions of the arsenious acid, boil, and let the condensed vapours of the mixture cool and fall down the sides again. Be very careful that these do not escape. If none of these have escaped, the proportions given will be correct; but if they do escape, probably a spot more bromine will have to be added to keep the mixture clear.

No mechanical directions can be given beyond these. Success is very much like that of a cook in his preparations, and the eye and understanding must regulate the proceedings. When made, the mixture should be about the consistence of toffee, and much the same in appearance. It should be handled with a piece of platinum wire. The more arsenic the better, and a grain or two of the metal itself may be coaxed in towards the end so long as the mixture remains clear. If properly made this will last, so far as I know, for ever."

Substitute for Glass for Covers and Slides for the Microscope.†—Dr. A. M. Edwards writes:—"I think the price of slides and covers for microscopic use is enormously high, and as they can be made of a substance much cheaper, and at the same time possessing properties which glass has not, viz. being unbreakable, that it should be known. In using celluloid, which is wood rendered soluble in ether and alcohol with gum camphor, for films for microphotography, I was struck with some of its properties, that made me think it could be used in microscopy. It is transparent, almost as transparent as glass, unbreakable, the weight is very little, making it especially valuable when sending by post, and therefore occupying very little room, which can thus be dispensed with. It is strong as wood, and stronger, has no fibre, and can be cut readily with scissors. I really wonder that it has not been used before for slides and covers. It can be obtained with a ground surface as well as plain, and the cost, which is a great item, is next to nothing. Very thin celluloid films are commonly used for instantaneous coverers, and this can be employed for covers, whilst the thicker kind used for

* Journ. Quekett Micr. Club, v. (1892) p. 123.

† Science Gossip, 1892, pp. 235-6.

ordinary photography makes capital slides. In fact, I have some an inch square, which I use in this way, mounting it temporarily in a glass slide for use on the Microscope. Let all microscopists try it, and they will not repent."

(6) Miscellaneous.

Microchemical Reactions of Cork and Cuticle.*—Herr A. Zimmermann discusses the mode of detection of these substances by the use of osmic acid, alkannin, and cyanin. Osmic acid, in a 1 or 2 per cent. solution, with warmth, causes a rapid and intense brown or black colour of all suberized membranes. When tannins are present, it is recommended to destroy them by eau-de-Javelle. Lignified are stained much more slowly than suberized membranes by osmic acid. A solution of alkannin in 50 per cent. alcohol, when warm, causes an intense colour in all suberized membranes. It is better to treat first with eau-de-Javelle. A very good reagent is obtained by mixing equal volumes of glycerin and a concentrated solution of cyanin in 50 per cent. alcohol; after previous treatment with eau-de-Javelle it brings out an intense blue staining of lignified and suberized membranes.

Microscopical Examination of Coal.†—In his researches Herr J. Wiesner uses a mixture of a concentrated aqueous solution of potassium bichromate and an excess of chromic acid, adding then sufficient water to dissolve the separated sulphuric acid. Oxidizable substances are by this process coloured a yellowish red which finally passes into green. Amorphous carbon will resist this reagent for months; its opaque particles form the chief ingredient of soot, of coal, of anthracite, and of black charcoal. Brown coal and brown charcoal are intermediate stages between pure carbon and cellulose, and a similar substance is found in anthracite. Soot contains, in addition, resinous substances which are rapidly dissolved by chromosulphuric acid. Graphite consists of a readily oxidizable substance and of small black granules which resist the reagent for two months. The black particles found in human lungs are identical with soot.

Microscopical Examination of Textile Fabrics.‡—Herr J. Vinzenz publishes a handbook for the microscopical examination of the fabrics of commerce, both animal and vegetable. The microscopic characteristics of the different fibres are described and delineated, and the microchemical reactions are given.

* Zeitschr. f. Wiss. Mikr., ix. (1892) pp. 58-69. See Bot. Centralbl., lii. (1892) p. 84.

† SB. K. Akad. Wiss. Wien, ci. (1892) pp. 379-418.

‡ 'Anleit. z. Mikrosk. Unters. d. Gespinnstfasern,' Cottbus, 1890. See Bot. Centralbl., lii. (1892) p. 153.

PROCEEDINGS OF THE SOCIETY.

MEETING OF 19TH OCTOBER, 1892, AT 20, HANOVER SQUARE, W.
G. C. KAROP, ESQ., M.R.C.S., VICE-PRESIDENT, IN THE CHAIR.

The Minutes of the Meeting of 15th June last were read and confirmed.

The List of Donations received since the last meeting—including as it did not only the ordinary accumulations of three months, but also a large number of journals and other publications which had not arrived in due course and had been applied for to complete sets—was submitted, and the thanks of the Society were given to the donors.

Proceedings of the Royal Institution, vols. i.-xii.	From <i>The Institution.</i>
Journal of the Dublin Microscopical Club, vol. iii. pt. 2 ..	<i>The Club.</i>
22nd and 23rd Reports of the Quekett Microscopical Club	"
A Review of the Work of the Leeuwenhoek Microscopical Club, 1867-91	"
Annual Report of the Belfast Nat. Hist. and Phil. Soc., 1867-78	"
Proceedings of the Belfast Nat. Hist. and Phil. Soc., 1872-78	<i>The Society.</i>
Report and Transactions of the Cardiff Naturalists' Society, vols. i., iii., iv., vi., viii., xi., and xxii. pt. 1	"
Proceedings of the Folkestone Natural History Society, ser. iv.-viii.	"
Fauna and Flora of the West of Scotland. (8vo, Glasgow, 1876)	<i>Natural History Society of Glasgow.</i>
Transactions of the Norfolk and Norwich Naturalists' Society, vols. iv. and v.	<i>The Society.</i>
Report of the Southport Natural History Society, 1892 ..	"
Annual Report of the Sidcup Literary and Scientific Society, 1885-90	"
Annual Report of the Postal Microscopical Society, xiv.-xvi., xviii.	<i>Mr. A. Allen.</i>
Scientific Enquirer, vol. iii. No. 25	"
Report and Transactions of the Cardiff Naturalists' Society, ii. and iv.	<i>Mr. W. H. Brown.</i>
Abstracts of the Proceedings of the Geological Society, 206 Nos.	"
Annual Report of the Ealing Microscopical and Natural History Society, 1885 and 1886	<i>Mr. R. T. Lewis.</i>
10th Report of the Quekett Microscopical Club	"

The Chairman thought it would be interesting to notice that they had before them for exhibition what he thought was the first practical Microscope yet made of aluminium. The great point about this instrument was of course its extreme lightness, the whole thing complete, including the condenser and eye-piece, only weighing 2 lb. 10 oz., as against the weight—7 lb. 13 oz.—of a precisely similar one made in the usual way of brass, or about one-third of the weight. This was a matter which would of course strongly commend it to persons who were much in the habit of carrying their Microscopes about from place to place.

It was perhaps not quite correct to say that every portion was of aluminium, because there were certain mechanical difficulties met with which prevented some portions from being made of that metal; for instance, he believed that it was almost impossible to cut a fine screw upon it, without the thread "stripping," and it was also found extremely difficult to solder, so that the necessary screws in the instrument were made of brass, and the Campbell fine-adjustment was of steel; the rack and pinion of the coarse-adjustment were also not made of aluminium to avoid the effects of wear, and the nose-piece was of German silver. The Microscope was—as they would see—made on Mr. Swift's well-known model. Another difficulty had been to get a good surface finish, since it appeared that the ordinary polishing process, such as was employed for brass and other metals, was not effective upon aluminium; he thought, however, that the surface was not at all bad, and as aluminium was not liable to tarnish from exposure to the air it was unnecessary to lacquer articles which were made of it in order to preserve their colour. He thought this instrument was well worthy of the attention of the Fellows of the Society.

Prof. F. Jeffrey Bell said that no doubt the Fellows of the Society would remember that at their meeting in May last a communication was read from Mr. J. C. Wright, of Edinburgh, as to some rotifers which he said he had found upon the gills of a newt, but which it was suggested at the meeting might have been Vorticellæ. Mr. Wright had now written to say that he had found that the supposed rotifers were *Spirochona tintinnabulum*.

Prof. Bell also read a letter which had been received from Mr. H. G. A. Wright, of Sydney, with reference to some photographs of *Podura* scales and of the blow-fly's tongue, in which he says, "In the February number of the R.M.S. Journal there is a discussion as to the nature of the markings on the *Podura* scale. A scale on a slide I have (purchased about three years ago from Beck) is deeply notched, and a little from the bottom of the notch, on the right-hand side, an exclamation mark has become detached and projects from the edge; it is plainly shown when observed with an apochromatic 1/12 N.A. 1.4 made by Powell and Lealand. Thinking it may be of interest I have photographed the upper part of the scale; unfortunately two or three other scales lie behind this portion of the notched scale and render the definition less crisp than it otherwise would be. The photograph is taken with a Powell and Lealand apochromatic 1/12 N.A. 1.40 (made about four years ago) and a No. 3 Zeiss projection eye-piece; direct lamplight is used (edge of flame) and a Powell and Lealand immersion condenser N.A. 1.4 (made of the new Jena glass). I also enclose three prints of microphotographs of the blow-fly's tongue, the $\times 180$ shows the suckers on the pseudo-tracheæ very finely; this is taken with a dry Powell and Lealand apochromatic 1/4 N.A. 1.95 (recently made for Dr. Morriss), and the No. 3 Zeiss projection eye-piece, using the edge of the lamp flame, and the same condenser as in the photo of the *Podura* scale. The slide of blow-fly's tongue (photo $\times 40$) was prepared

by Mr. H. Sharp, of Adelong, New South Wales, about eight years ago; the tongue is mounted in a saturated solution of bimiodide of mercury in a saturated solution of iodide of potassium, and is similar to one shown at the R.M.S. in November 1884."

The Chairman said that he could not be sure, from the cursory examination he had been able to make, that the exclamation marking referred to in the letter was to be seen, but the photographs of the blow-fly's tongue were certainly remarkably good.

Prof. Bell said that Mr. Nelson—to whom these photographs were originally sent—had written a letter much to the same effect, recommending them to the notice of the Society, and practically agreeing with what Mr. Karop had just said.

Dr. C. E. Beevor read a paper "On Methods of Staining Medullated Nerve-fibres," illustrating the subject by photomicrographs, and by a number of preparations exhibited under Microscopes in the room (see p. 897).

The Chairman said they were much indebted to Dr. Beevor for his very interesting paper. Most of the processes mentioned had been described from time to time in the Journal of the Society, but now they had an excellent résumé, which would no doubt be very useful to refer to. It was of course a very good thing to be able to differentiate nerve-fibres in the ways which had been described, but it was a pity that they could not also so differentiate them as to show from which part of the nervous system they came. If this could be done he need hardly say it would be of great value, but he supposed it was rather beyond them at present.

The thanks of the meeting were unanimously voted to Dr. Beevor for his paper.

Prof. Bell said that the next paper on the Agenda was one by Mr. G. Massee "On *Heterosporium asperatum*." It was printed in the number of the Journal just issued, with a plate in illustration, but he had hoped that Mr. Massee would have been present at the meeting to have pointed out to them by means of diagrams the chief points of interest in his paper. In his absence the paper would be taken as read (see p. 577).

Dr. H. G. Piffard's letter "On the use of Monochromatic Yellow Light in Photomicrography," was read by Prof. Bell (see p. 868).

The Chairman expressed the indebtedness of the Society to Dr. Piffard for his interesting communication upon a subject which was receiving a good deal of attention at the present time.

Mr. T. Charters White said he should very much like to see some of the results of the procedure which had been described in this paper, because he had himself tried a very similar process with monochromatic light obtained by using screens and solutions, but the chief difference he found was that it very much prolonged the time necessary for exposure. When he used a solution of copper as a screen he found that a ten minutes' exposure gave no result whatever, and that with an

exposure of twenty minutes he got just the ghost of an image, whereas with the light of an ordinary paraffin lamp he obtained a beautifully developed picture in a very much shorter time. If Dr. Piffard had sent any specimens taken in the way described in his paper, he should very much like to see them.

Prof. Bell said that no specimens had been received.

Mr. C. Haughton Gill said that he had used the copper light-filter for the same purpose, and had found that by its aid any good ordinary lens would give as good results as you otherwise would get by using an expensive apochromatic, because it filtered off all the rays except those which were visually strong. His experience was that no advantage was to be obtained by expensive lenses over others when this method was adopted, for with this light-filter he could get just as good a picture with an objective such as cost about 30s. as he could with one costing 10l. He had not found in the course of his own work that the use of this light prolonged the exposure, that was to say, that with a magnifying power of $\times 300$ and an exposure of ten minutes he could with the isochromatic plates get a good strong printing image.

The Chairman said that in the absence of Mr. Massee they had come to the end of their Agenda; it only remained for him to remind them of the *Conversazione* on November 30th, and to adjourn the meeting to November 16th.

The following Instruments and Objects were exhibited:—

Dr. C. E. Beevor: Photomicrographs and sections illustrating his paper.

Mr. H. G. A. Wright: Photomicrographs of *Podura* scale and of the Blow-fly's tongue.

Messrs. J. Swift:—Aluminium Microscope.

New Fellows:—The following were elected *Ordinary* Fellows:—
Messrs. Charles Edmund Aikin, Frank Campion, and Camille Charles Muiron.

MEETING OF 16TH NOVEMBER, 1892, AT 20, HANOVER SQUARE, W.,
THE PRESIDENT (DR. R. BRAITHWAITE, F.L.S.) IN THE CHAIR.

The Minutes of the meeting of 19th October last were read and confirmed, and were signed by the President.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Monograph of the Palæontographical Society, 1891	Mr. F. Crisp.
A Guide to the Science of Photomicrography. By E. C. Bousfield. (8vo, London, 1892)	The Author.
A Contribution to our Knowledge of Seedlings. By the Right Hon. Sir John Lubbock, F.R.S. 2 vols. (8vo, London, 1892)	"

Prof. F. Jeffrey Bell said there were amongst these donations several to which he should like to call the special attention of the Fellows of the Society. The first of these was the 46th volume of the Proceedings of the Palæontographical Society, presented to them by Mr. Crisp as an addition to the valuable series which they already possessed. Then there was one by Dr. Bousfield, entitled 'A Guide to the Science of Photomicrography,' which would doubtless be appreciated by those whose attention had been devoted to such matters. And they were further indebted to Sir John Lubbock for a copy of his new book, 'A Contribution to our Knowledge of Seedlings,' which, so far as he could judge from a slight glance, was no mean contribution in itself.

Mr. A. W. Bennett thought they should not pass this book without some special notice. It embodied an account of a very large number of experiments which had been carried on at Kew Gardens during some years, and gave a variety of details as to the early growth of the seedlings in the case of a vast number of plants, so that it was a perfect storehouse of knowledge in a very interesting and important branch of botanical science. He thought, therefore, that the special thanks of the Society were due to Sir John Lubbock for this donation.

A special vote of thanks was agreed to accordingly.

Mr. T. F. Smith read a note "On the Character of the Markings on the Podura Scale," with special reference to the communications recently made to the Society on the same subject by the Hon. J. G. P. Vereker, Dr. A. C. Mercer, and Mr. H. G. A. Wright. A number of photomicrographs in illustration of the subject were handed round for inspection.

Prof. Bell said he had received a letter from Mr. Ernest Hart, with reference to certain classes at Toynbee Hall for which some Microscopes were greatly needed, and asking for the loan of instruments for the use of the students at that institution. He had replied to the effect that, so far as the Society was concerned, they were not in a position to comply with the request, but he promised to lay the matter before that meeting in the hope that, if there were any Fellows of the Society present who had Microscopes for which they had no further use, they might see their way to lend them for the purpose.

Prof. Bell also called attention to the *Conversazione* of the Society to be held on the 30th instant. The notices which had been sent out asked that Fellows who intended to exhibit would send in their names by the 16th, but the Assistant-Secretary had up to the time of meeting received replies from less than forty Fellows. He hoped that as soon as Fellows had made up their minds they would lose no time in communicating their intention, as the date was drawing near and the number who had already sent in their names was considerably below that for which accommodation had been provided. The success of the occasion, of course, largely depended upon the support which it received from those willing to assist.

An account of Mr. W. West's paper "On the Freshwater Algæ of the English Lake District" was given by Mr. Bennett, who said that, although the paper was in itself too technical to bear reading at the meeting, it formed an exceedingly important contribution to their knowledge of the algæ of this country, and would add greatly to the value of their Journal by its publication. The list given comprised a very large number of new species, and one new genus—*Tetracoccus*—which he thought had every right to be so considered. He had himself, as they knew, found a great many new species in the same localities, and it was a strong testimony to the thoroughness of Mr. West's work to find that every one of these species was included in his list.

The President thought that a paper like the one before them showed how great was the value of the instrument with which they were accustomed to work, and also that Mr. West must have an extraordinary eye for detecting these organisms, many of which were so very minute in character.

Mr. F. Chapman gave a *résumé* of his paper, being Part 3 of his description of the Foraminifera of the Gault of Folkestone, the preceding portions of which have already been published in the Society's Journal.

Mr. C. Haughton Gill read his paper "On a Fungus internally Parasitic in certain Diatoms," the subject being freely illustrated by reference to a number of specimens under Microscopes in the room and by photomicrographs placed in the hands of the Fellows for examination. At the conclusion of the paper the subject was further illustrated by the exhibition on the screen of a series of photomicrographs, which, beginning with a healthy specimen of *Pleurosigma*, showed in succession others which were infested with the fungus in various degrees; an isolated spore-sac $\times 400$ was also shown, and, in addition, two specimens of *Nitzschia* and one of *Cocconema* similarly affected.

The President felt sure that all present would agree that a hearty vote of thanks was due to Mr. Gill for his paper, and for the excellent way in which it had been illustrated. He should like to ask if these specimens had been observed in many localities, or were they peculiar to one?

Mr. Gill said he was unable to say whether the fungus was widely distributed, because, personally, his opportunities for collecting were very much restricted to one collecting place—the New River. There, however, diatoms could be got by the ounce. Though the gatherings contained examples of the greater number of British freshwater species, those which he had mentioned were the only ones in which the fungoid growths had been found.

Mr. G. C. Karop thought Mr. Gill had certainly given them a very excellent paper upon what appeared to be the first observations made in this country upon these remarkable fungoid growths. He thought that Zopf mentioned that he had found them also in *Pinnularia*, and he had also remarked that at different times they seemed to prefer different diatoms.

Mr. Bennett said there could be no doubt that all who were acquainted with algæ or diatoms would regard this paper as one of extreme interest. He should like to refer to one or two points which had occurred to him in connection with the subject, and especially to mention that in the allied family of desmids he had observed structures which he thought might be of similar character, and he had noticed that they quite agreed in the habit of attacking one or two species only, so that in a gathering containing many species one might be found infested and the others quite free. He should like to inquire if by the term spores Mr. Gill did not mean zoospores? Had he observed them to be possessed of vibratile cilia? Or could he form any idea as to how they came to be inside the diatoms? He could hardly think they would be able to penetrate the fully formed siliceous shells, though they might get through during earlier stages of growth when the envelope was less completely hardened. It was perhaps possible that they might be transmitted in some way by inheritance, and if so that might account for their great abundance in a particular species, but not in others in the same gathering. There were so many interesting points which cropped up in connection with this subject that he wanted to be able to see it in print in order to take them into consideration.

Prof. Bell hoped that if Mr. Gill had assured himself that Zopf's paper was not in their library, as he imagined, he would let Mr. Brown have its full title in order that a copy might be obtained.

Mr. Karop said that the paper originally appeared in the 'Nova Acta,' and therefore it was certain they must have it.

Mr. Bennett said the paper had come under his notice in some way, and his impression was that it had been noticed in the Journal.

Mr. Gill said that the question as to how these things originally got into the diatoms was one still under consideration; he had therefore particularly avoided saying anything definite upon the subject because he had not yet worked it out. As to the movements of the spores, he was not at present perfectly certain that they moved at all more than a very short distance from the orifice of the beak, but he had not yet had time to examine them sufficiently to be able to answer the question as to whether they were ciliated.

Mr. Karop thought Zopf said that they got into the diatoms.

Mr. Gill said this was quite possible, because diatoms were by no means the tightly shut up boxes which they were supposed to be. They could not live or absorb nutriment unless there was some sort of passage, and he thought there was very likely a means of penetration all over them to admit of the diffusion of fluid throughout.

Dr. P. M. Braidwood thought that a very important point was involved in this question of cultivation, which if decided, might yield great results. They were dealing with very minute organisms, and the suggestion made appeared to him to be a very pregnant one indeed, so that he hoped some one would give it the attention which it seemed to deserve.

The President was sure that all who were interested in the subject would agree that this was probably only the beginning of what might be a very important series of observations.

Prof. Bell said they had another paper upon the Agenda for the evening, upon a new rotifer, *Notops ruber*, by Mr. J. Hood, but as that gentleman had since intimated that he had a further paper bearing upon the same subject, they had decided to take both at their next meeting. Mr. Hood had, however, sent up a number of living specimens of the new rotifer, which were being shown under the Microscopes on the table, and Mr. Rousselet would say something about them so as to direct attention to them whilst there was an opportunity of seeing them.

Mr. C. Rousselet was sorry to say that they were nearly all dead, having unfortunately been too tightly corked up in a bottle without sufficient air.

Mr. E. M. Nelson said that as priority of invention occupied a place in the Proceedings of the Society it might interest the members to know that the reflecting paraboloid (generally called Wenham's paraboloid) is figured as an illuminator for the Microscope in Goring and Pritchard's 'Micrographia' (1837) p. 188, fig. 8, where it is stated to be the invention of the Rev. Mr. Packman.

Mr. Nelson also referred at some length to the structure of the Microscope made by Messrs. Watson for Dr. Van Heurck, especially as regarded the fine-adjustment which was the subject of strong adverse criticism at the Society's meeting of 20th May, 1891.* On that occasion the chief ground of objection taken was that the fine-adjustment being made on Zentmayer's plan, which did not last, would be sure to fail in the same way, for the same reasons. Messrs. Watson had placed the instrument in his hands that he might independently test it, and he found that the fine-adjustment was not the same as Zentmayer's because it was provided with spring stops which entirely obviated the evils complained of. A matter of some value which had been overlooked, was that the fine-adjustment screw was left-handed, by means of which the apparent and real motions were made to coincide, which was often a great advantage when working with high powers. He had worked with this Microscope for some time and had tested it in such a way as to enable him to speak of it with great confidence, and having found that the chief objection against it was one based upon a mistake, he felt sure it would be to the credit of the Society that the facts should be stated, and that the adverse criticism should not stand.

Mr. J. E. Ingpen said, with regard to the remarks made by Mr. Nelson as to the paraboloid illuminator, his own impression was that as it appeared in Goring and Pritchard it was only in the way of a suggestion, and that there was no reference to any stop for obtaining a black ground such as that employed by Mr. Wenham. He was speaking only from memory, but he thought he was right in saying that it seemed likely that the idea as it appeared in Goring and Pritchard was never carried out practically.

Mr. Gill, having a lantern in the room at his disposal, took the opportunity of exhibiting an interesting series of photomicrographs of diatoms intended to demonstrate the nature of the markings by the

* This Journal, 1891, pp. 399, 434, 558.

appearances presented after they had been filled up with deposits of sulphides of mercury, silver, &c., in the manner described in his paper read before the Society at the meeting of 15th April, 1891.* The fifteen slides shown on the occasion included specimens of *Coscinodiscus*, *Suriella*, *Cocconema*, *Stauroneis*, *Pleurosigma*, *Pinnularia*, *Arachnodiscus*, *Aulacodiscus*, and *Triceratium*, which had been treated by Mr. Gill's process in various ways.

The following Instruments, Objects, &c., were exhibited:—

Mr. F. Chapman: Foraminifera of the Gault of Folkestone.

Mr. C. H. Gill: Specimens, Photomicrographs, and Lantern Slides illustrating his paper.

Mr. J. Hood: *Notops ruber*.

Mr. E. M. Nelson: Messrs. W. Watson's Microscope.

Mr. T. F. Smith: Photomicrographs of *Podura*.

New Fellows:—The following were elected *Ordinary* Fellows:—
Messrs. Richard Smith, H. W. Westover, and Francis K. Wardle.

* This Journal, 1891, p. 441.

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ERRATA.

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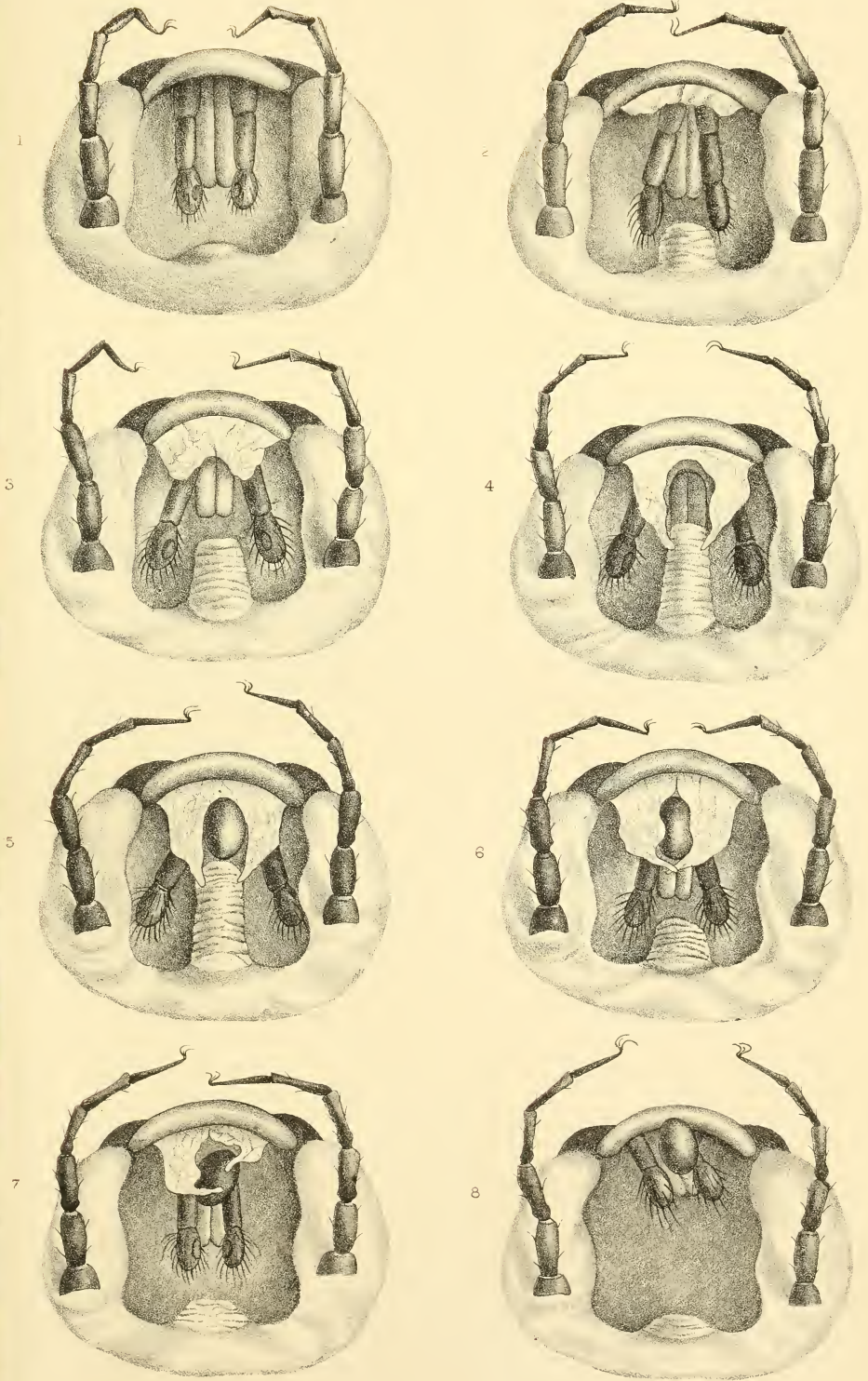
Page 859, Charrin, Chemical Nature, &c., for p. 649 read p. 647.

" 863, line 16 from bottom, for "Cladasporiæ" read "Cladosporeæ."

" 882, line 22, for "Cells" read "Callus."

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Page 394, line 10 from bottom, for "Angiosperms" read "Gymnosperms."

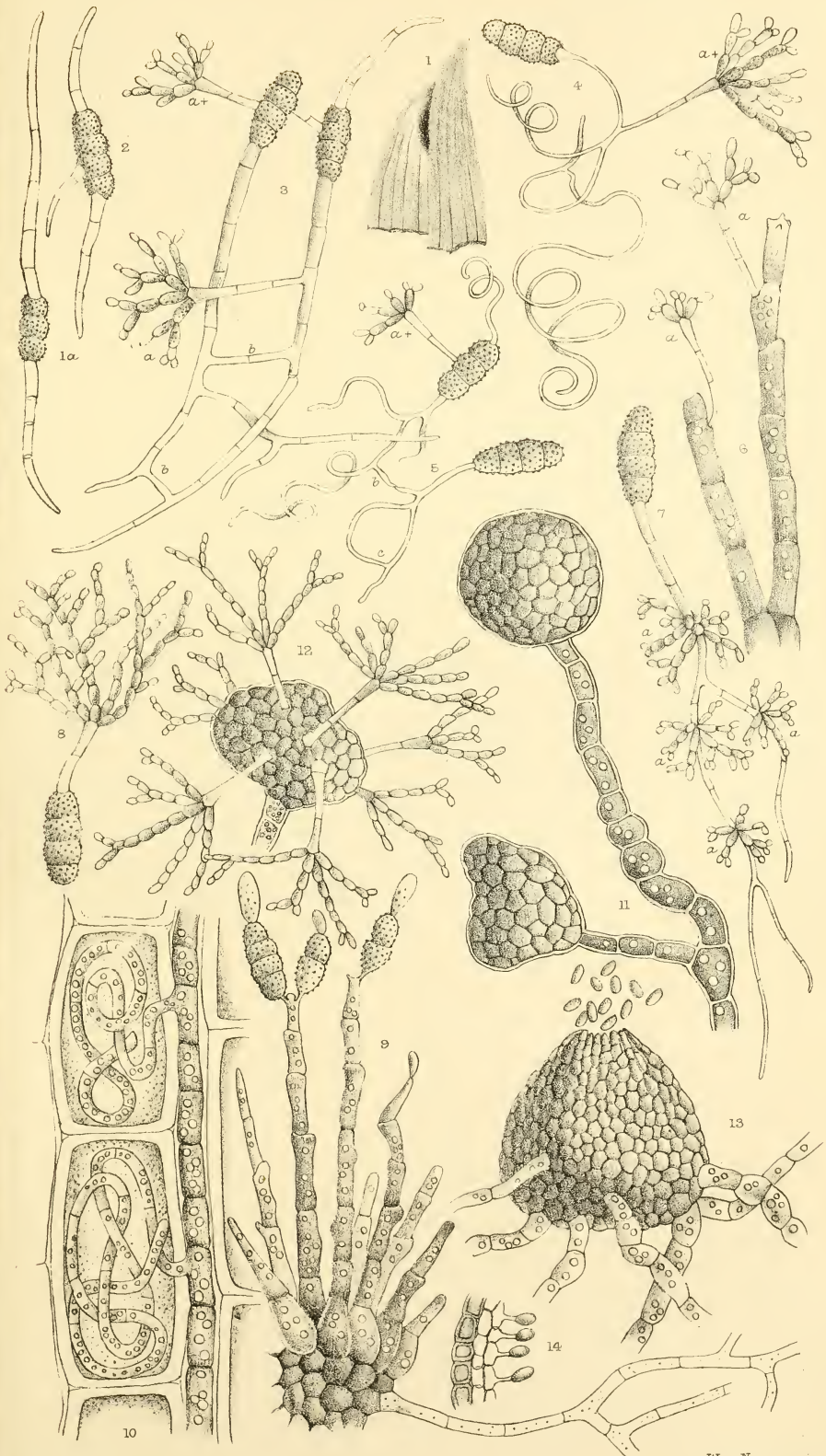


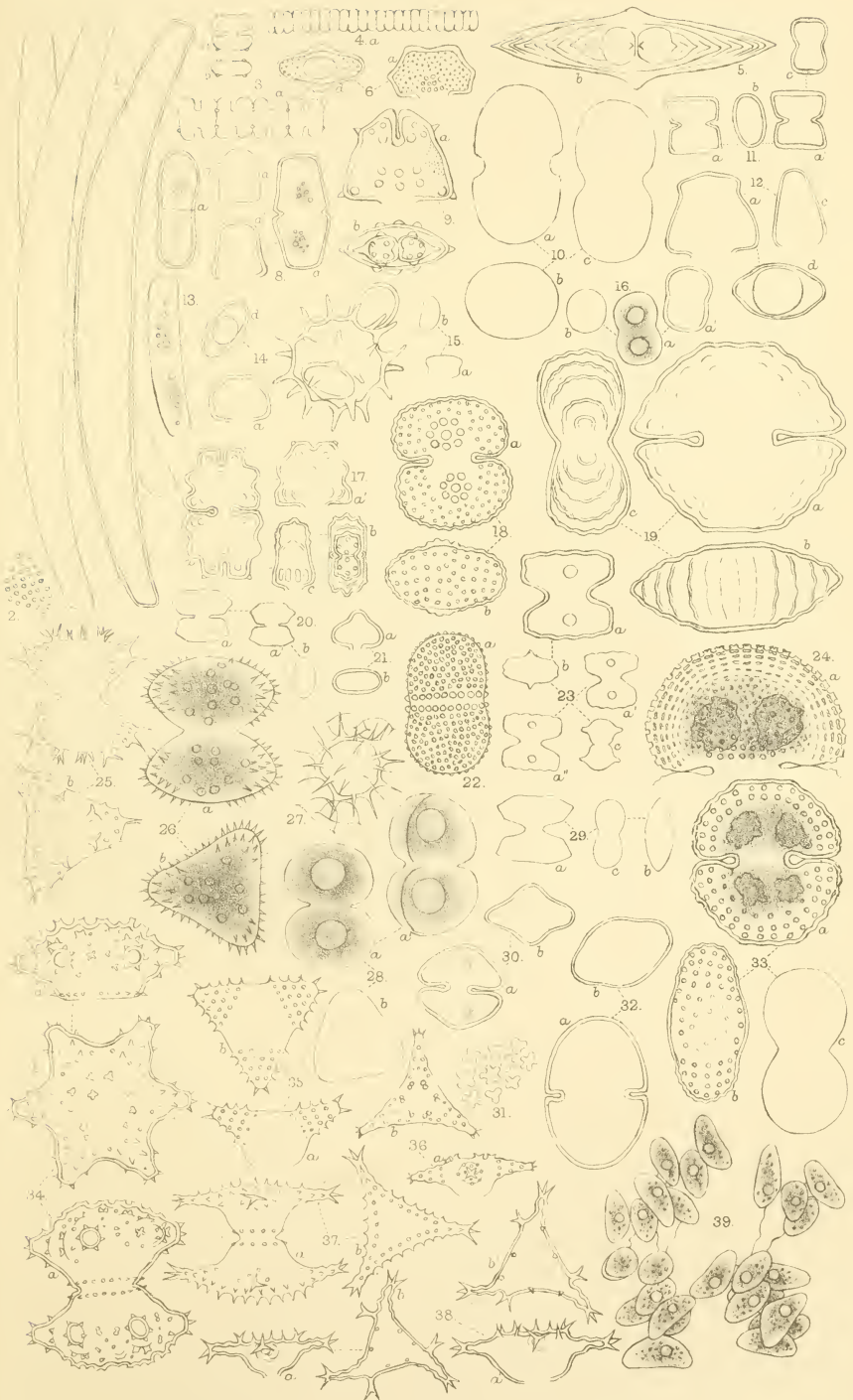
R. T. Lewis, del. ad nat.

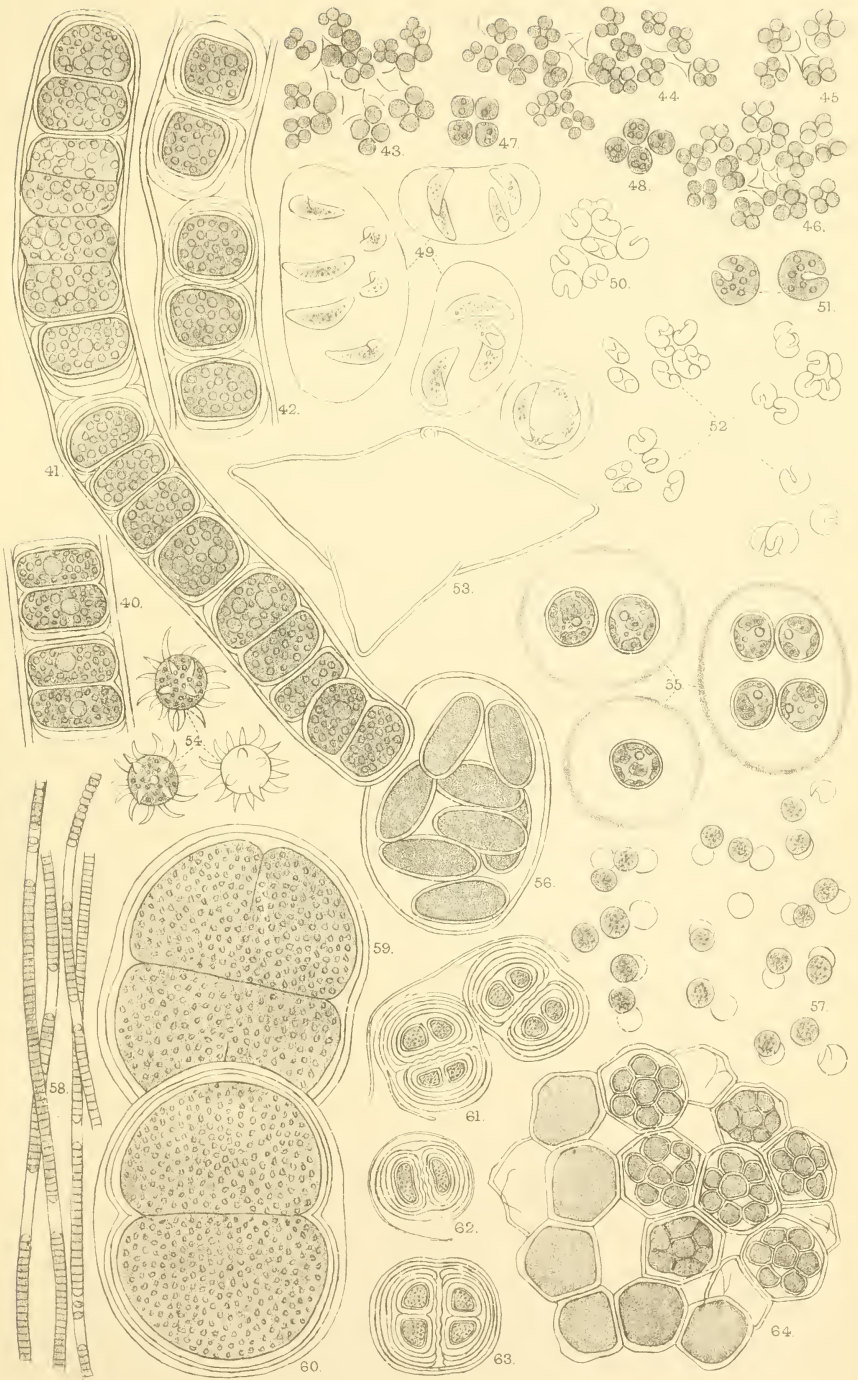
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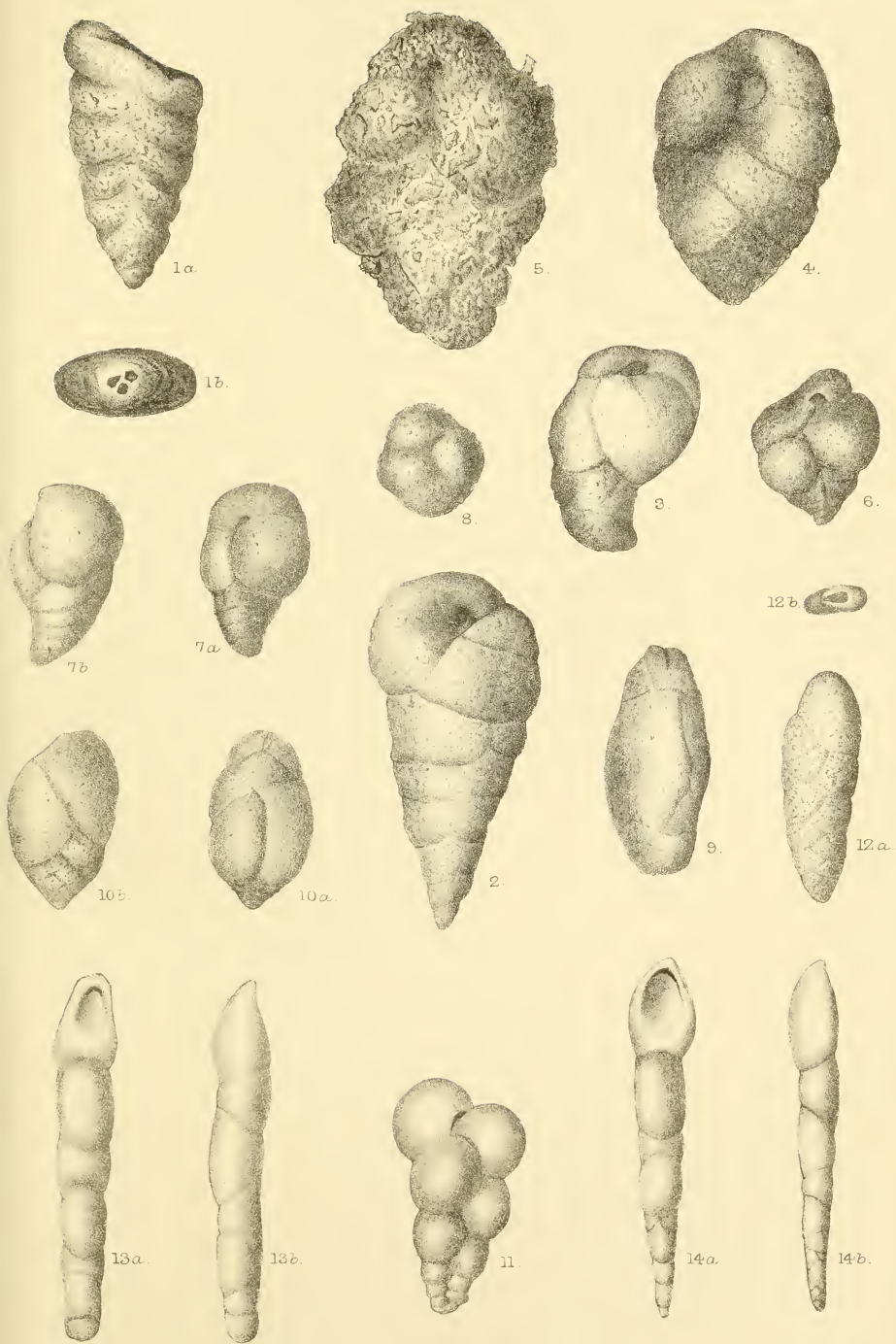


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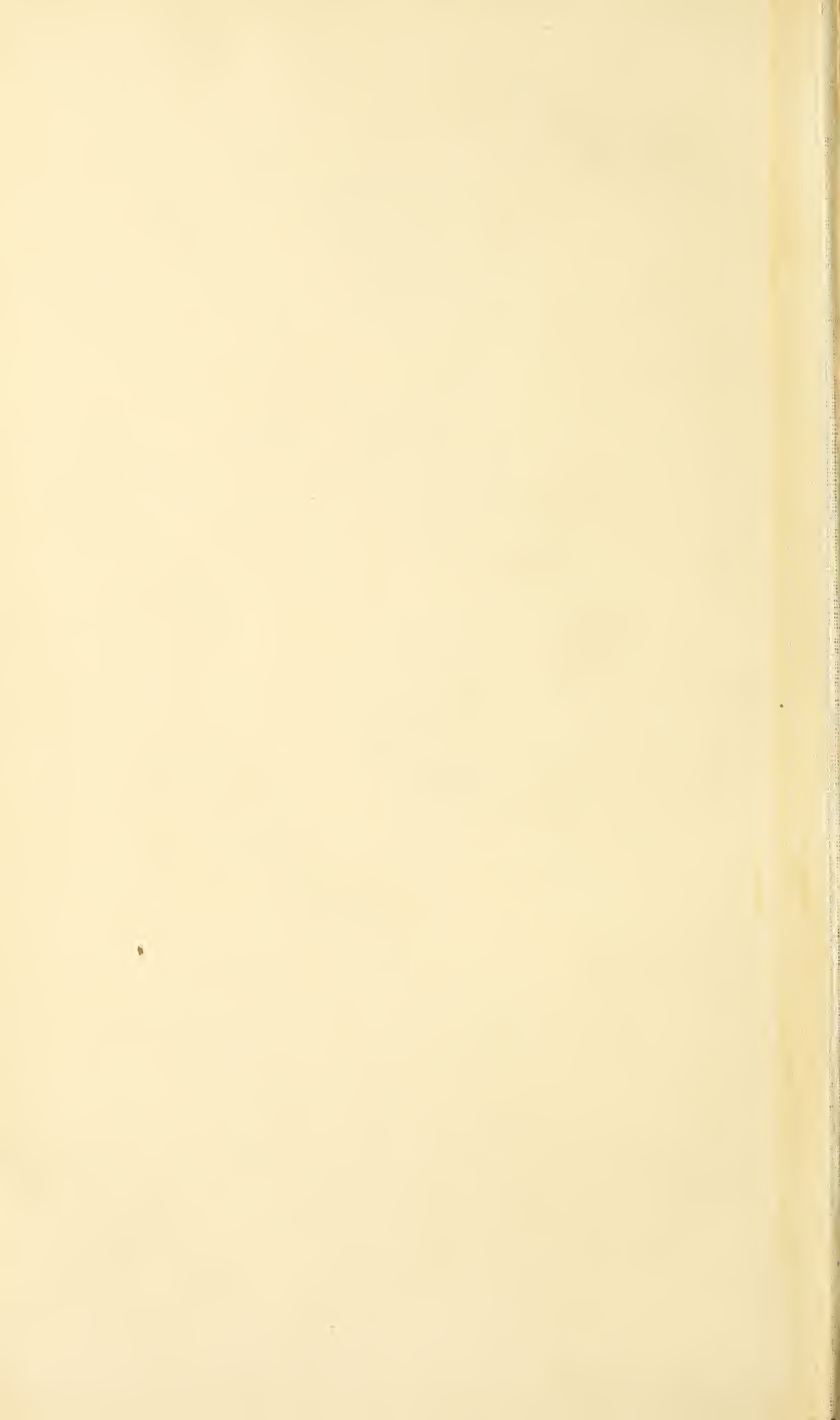


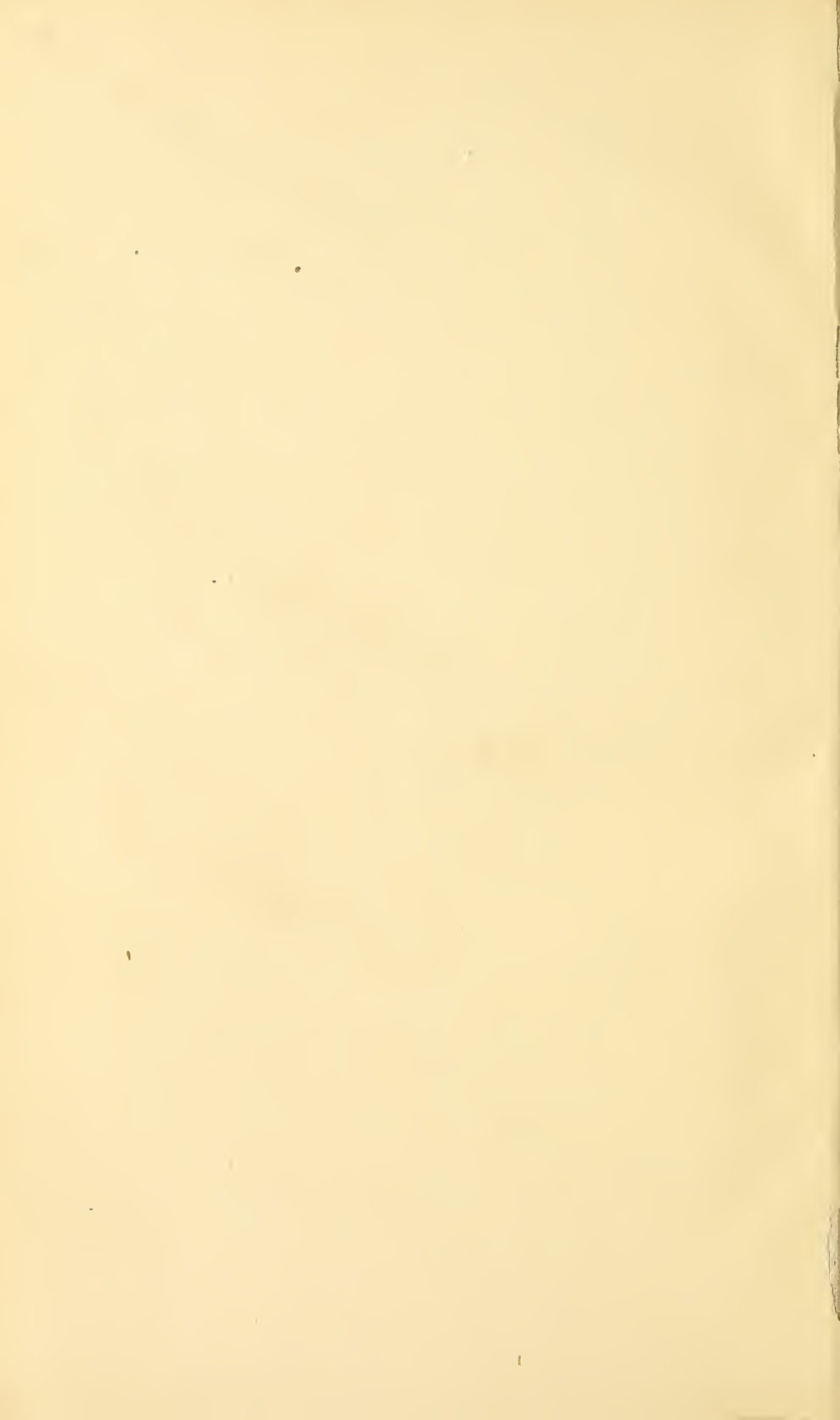


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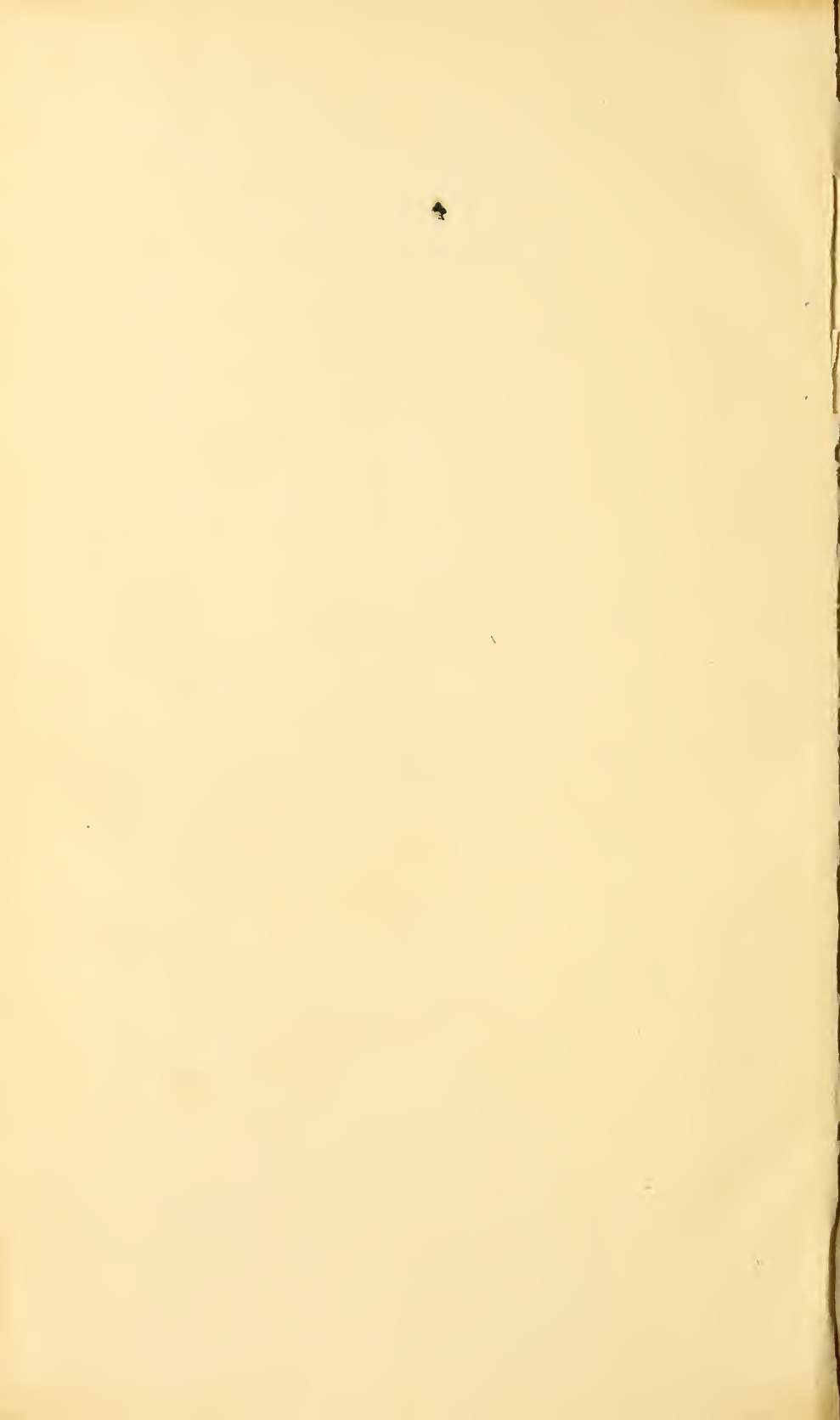
West, Newman
E.C. Knight } lith.

Folkestone-Gault Foraminifera.











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