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,
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J. ARTHUR THOMSON, M.A.,
Lecturer on Zoology in the School of Medicine, Edinburgh,

FELLOWS OF THE SOCIETY.

FOR THE YEAR

1893.

LONDON:

TO BE OBTAINED AT THE SOCIETY'S ROOMS,

20 HANOVER SQUARE, W.;

OF MESSRS. WILLIAMS & NORGATE; AND OF MESSRS. DULAU & CO.

THE

Royal Microscopical Society.

(Established in 1839. Incorporated by Royal Charter in 1866.)

The Society was established for the promotion of Microscopical and Biological Science by the communication, discussion and publication of observations and discoveries relating to (1) improvements in the construction and mode of application of the Microscope, or (2) Biological or other subjects of Microscopical Research.

It consists of Ordinary, Honorary, and Ex-officio Fellows, without distinction of sex.

Ordinary Fellows are elected on a Certificate of Recommendation, signed by three Ordinary Fellows, setting forth the names, residence, and description of the Candidate, of whom the first proposer must have personal knowledge. The Certificate is read at two General Meetings, and the Candidate balloted for at the second Meeting.

The Admission Fee is 2*l.* 2*s.*, and the Annual Subscription 2*l.* 2*s.*, payable on election, and subsequently in advance on 1st January annually, but future payments may be compounded for at any time for 31*l.* 10*s.* Fellows elected at a meeting subsequent to that in February are only called upon for a proportionate part of the first year's subscription. The annual Subscription of Fellows permanently residing abroad is 1*l.* 11*s.* 6*d.*, or a reduction of one-fourth.

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In each Session there is a Conversazione devoted to the exhibition of Instruments, Apparatus, and Objects of novelty or interest relating to the Microscope or the subjects of Microscopical Research.

The Journal, containing the Transactions and Proceedings of the Society, and a Summary of Current Researches relating to Zoology and Botany (principally Invertebrata and Cryptogamia), Microscopy, &c., is published bi-monthly, and is forwarded post-free to all Ordinary and Ex-officio Fellows residing in countries within the Postal Union.

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

(3) Structure of Tissues.

(4) Structure of Organs.

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(1) Reproduction and Embryology.

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

(3) Irritability.

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The Journal is issued on the third Wednesday in
February, April, June, August, October, and December.

1893. Part 1. 6994 FEBRUARY. To Non-Fellows, Price 6s.

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CONTENTS.

β. Bryozoa.

Arthropoda.

α. Insecta.

δ. Arachnida.

ε. Crustacea.

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B. CRYPTOGAMIA.

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Algæ.

Fungi.

MICROSCOPY.

a. Instruments, Accessories, &c.

(1) Stands.

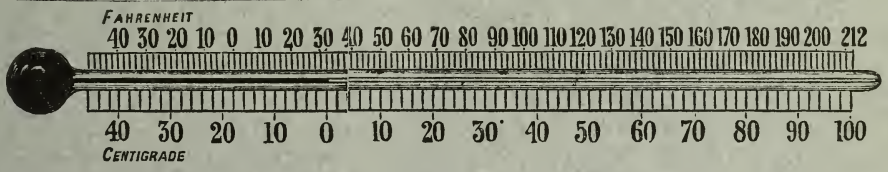
(3) Illuminating and other Apparatus.

β. Technique.

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 $\left(\frac{1}{a}\right)$
	Air ($n = 1{\cdot}00$).	*Water* ($n = 1{\cdot}33$).	*Homogeneous Immersion* ($n = 1{\cdot}52$).	White Light. ($\lambda = 0{\cdot}5269\ \mu$, Line E.)	Monochromatic (Blue) Light. ($\lambda = 0{\cdot}4861\ \mu$, Line F.)	Photography. ($\lambda = 0{\cdot}4000\ \mu$, 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

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	- 21·1
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	- 22·2
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	- 23·3
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	- 24·4
203	95	149	65	95	35	41	5	- 13	- 25
202	94·44	148	64·44	94	34·44	40	4·44	- 14	- 25·5
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	- 26·6
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	- 27·7
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	- 28·8
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	- 31·1
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	- 32·2
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	- 33·3
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	- 34·4
185	85	131	55	77	25	23	- 5	- 31	- 35
184	84·44	130	54·44	76	24·44	22	- 5·56	- 32	- 35·5
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	- 36·6
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	- 37·7
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	- 38·9
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	- 41·1
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	- 42·2
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	- 43·3
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	- 44·4
167	75	113	45	59	15	5	- 15	- 49	- 45
166	74·44	112	44·44	58	14·44	4	- 15·56	- 50	- 45·5
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	- 46·6
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	- 47·7
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	- 48·8
159·8	71	105·8	41	51·8	11	- 2·2	- 19	- 56·20	- 49
								- 58	- 50



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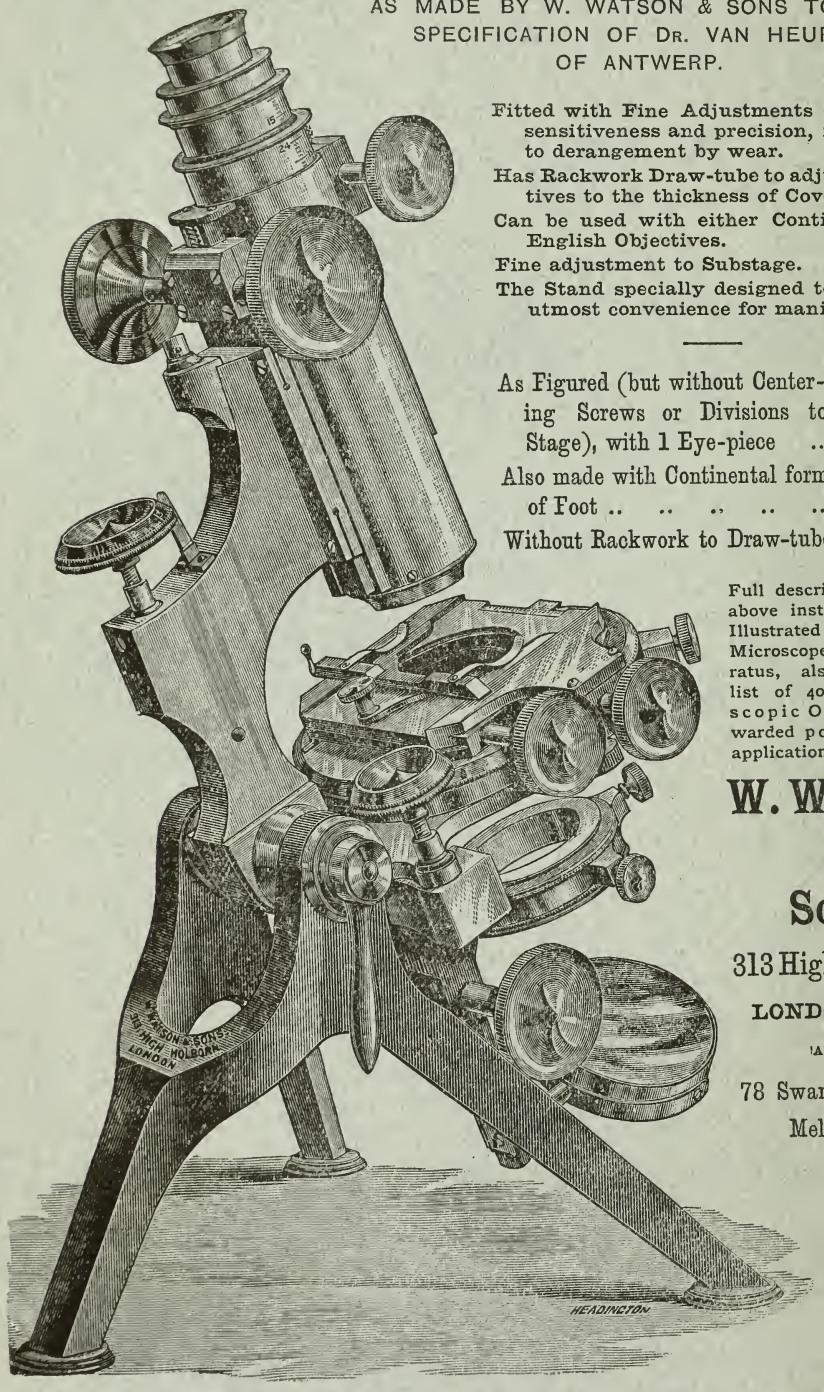

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OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY 1893.

TRANSACTIONS OF THE SOCIETY.

I.—*On an Endophytic Parasite of Diatoms.*

By Charles Haughton Gill, F.R.M.S., F.C.S.

(*Read 18th November*, 1892.)

Plate I.

During the late autumn of 1891, while examining some large gatherings of diatoms from the New River, near London, in search of instances of conjugation, I observed several cases of what I at first took to be the formation of sporanges by *Pleurosigma attenuatum* itself. Further observation, however, makes it almost certain that the spore-sacs in question are the zoosporanges of a fungus similar to, if not identical with the *Ectrogella bacillariacearum* described and named by Zopf,* as infesting *Synedra* and *Pinnularia*.

In general characters they agree with Zopf's description and figures of *Ectrogella*, except in the point hereinafter mentioned, and differ in form only as they might be expected to do when developed within the shorter, wider shells of *Pleurosigma*, instead of the exceedingly long and narrow *Synedra*.

These spore-sacs, as contained in *Pleurosigma*, are sausage-shaped

EXPLANATION OF PLATE I.

Fig. 1.—*Pleurosigma attenuatum* with single sporange in early stage. × 300.
„ 2. „ „ „ two „ „ × 309.
„ 3. „ „ „ single „ with beak on the point of bursting. × 300.
„ 4.—*Pleurosigma attenuatum* with three sporanges, one discharging zoospores. × 300.
„ 5.—A sporange separated from shell and discharging zoospores through beak. × 465.
„ 6.—*Cocconema lanceolatum* with single sporange in early stage. × 300.
„ 7.—A *Nitzschia* with two sporanges before appearance of discharge beaks. × 300.
„ 8.—A *Nitzschia* with two sporanges with two discharge beaks. × 300.
„ 9.—*Nitzschia sigmoidea* with single very elongated sporange. × 300.

* Zopf, 'Zur Kenntniss der Phycomyceten,' Nova Acta K. L. C. Deut. Akad., xlvii. No. 4, p. 145, partly translated by Mr. Karop in Journ. Quek. Club, 1887, p. 115.

bodies consisting of a firm envelope of cellulose (which is coloured purple by chlor-iodide of zinc), containing a greenish-brown endoplasm which at first is very slightly granular, but which draws up into isolated particles having a sort of mulberry outline as maturity approaches.

At this stage the cell-wall becomes tumid at one point, and forms a process, or beak, which forces its way out between the two shells of the diatom, gradually elongates, and then bursts at its extremity. Through this beak the contents of the sac are discharged, sometimes with great rapidity, into the surrounding water, in the form of a cloud of minute zoospores endowed with a great power of rapid motion. The beaks or discharging tubes are often of considerable length, say half that of the diatom itself. I have never seen more than one beak or discharging tube proceeding from any one sac out of the hundreds I have had under observation, though Zopf says of his *Ectrogella*, "I have counted as many as ten, and the fact of many excretory ducts being formed in the larger sporangia is particularly characteristic of *Ectrogella*. The medium sized usually possess from three to five, but sometimes only two."

A single *Pleurosigma* may contain more than one sporange, and though one or two is the most common number, eleven have been counted in one shell. As a general rule each sac is quite simple, but I have observed several somewhat doubtful instances of their being bifurcated. Zopf says of the sporanges of his *Ectrogella*, "They are never branched."

I have not as yet been able to trace the development of the zoospores after they have left the sac, as they speedily become mixed and confounded with the surrounding *débris* of all sorts accompanying the specimens. Though it is easy to separate a sac-bearing specimen and isolate it on a clean slide, the necessary manipulation seems to completely arrest its powers of further development, and no emission of zoospores has taken place in any one instance out of the many experiments made.

Of what particular organism these sacs are the zoosporanges can only be finally determined by getting their contained zoospores to develope under observation, and then tracing the resulting growth to its ultimate form. Hitherto, as noted above, I have failed to get any growth from them under conditions which render accurate observation possible, though I have kept the sporanges under constant, or rather regular, observation for weeks at a time, while they were immersed in plain river water, or in culture fluids in which diatoms increase and multiply. Among other culture fluids tried was what might be called "diatom soup," made by boiling down a large quantity of fresh diatoms, and preserving the filtered extract in sterilized and sealed tubes. This should give a medium having all the necessary elements for the nutrition of these zoospores, whether they be those of the diatom itself or of an endophytic parasite.

The very high authority of Zopf as a cryptogamic botanist, gives the greatest possible weight to his opinion that the sacs which he observed were really the mycelial sacs of some species of *Ancylista* (a parasitic fungus), but as he too failed to get any growth from them or their contents, their exact nature is still open to some degree of doubt.

It is, indeed, hard to understand how it should come about that a fungus which was present in such abundance, and in such an active state as to attack thousands of individuals of *Pleurosigma*, should not invade one of the almost equally numerous *Nitschiæ*, *Pinnulariæ*, or other diatoms which were confined in the same limited volume of water for weeks together. But such was the case. No trace of a mycelium from which such spore-sacs might arise could be discovered.

The first gathering in which these bodies were observed (and I had been examining similar gatherings from the same spot, at short intervals throughout the spring and summer) was made in the beginning of November. It was kept in an open shallow dish and examined daily. At first only one or two specimens could be found even after long search, but in the course of a week or two examples became more numerous, among those diatoms which were still left alive. In the beginning of December many specimens could be found in each "dip," but by the middle of the month the greater number of the sacs had put forth their beaks and discharged their contents.

A fresh gathering was made from the same spot on Dec. 19. On examination no *Pleurosigma* with fully-formed sacs could be found. It was kept in an open dish and examined every few days, but it was not till the 2nd January that complete spore-sacs were observed. From this time the number rapidly increased up to the 22nd of the month, and then as rapidly decreased, till by the 31st there were hardly any but discharged and empty sacs to be found.*

A third gathering made at the beginning of March, and kept under the same conditions as the other two, failed to give any specimens of *Pleurosigma* in this peculiar state.

All through the succeeding spring and summer these sac-bearing *Pleurosigma* were sought—but not one specimen found. So far their occurrence appears to be seasonal.

In October of this year (1892) I again found a few specimens, but up to the beginning of November only very few, and even in December they are scarce as compared with last year. The fact that in no case have more than a few scattered specimens been found in quite fresh-gathered (and therefore presumably healthy) material, but

* Observations made in November and December 1892 and January 1893, have completely coincided with those of the previous year. Now, at the end of January, I am unable to find one *Pleurosigma* with a spore-sac.

that their number increased on keeping under relatively unhealthy conditions, argues strongly in favour of the conclusion that these sacs really are due to some parasitic fungus and are not proper to the healthy diatom.

Though the gathering made in the beginning of March gave no sac-bearing specimens among the thousands of *Pleurosigma* present, it did contain large numbers of a *Bacillaria* (or small straight *Nitzschia*) with very similar zoosporanges to those in *Pleurosigma* enclosed. No other diatoms were affected, though *Pinnularia*, *Cocconema*, *Amphora*, *Surirella*, *Campylodiscus* and *Cymatopleura* were abundant.

If further observations should confirm the first and establish the fact that diatoms of different species bear these sporanges only at a season peculiar to each, it will be necessary to believe either that these spore-sacs are proper to the diatom itself, or that there are a number of distinct parasitic fungi, each of which has its own season for the development of sporanges, and each of which can only find an appropriate host in one particular species (or genus) of diatom.

I am induced to bring forward these very incomplete results by the consideration that, as there is great uncertainty about finding the material for confirmatory observations and experiments, it is almost necessary that more than one pair of eyes and hands should be at work on the subject if it is to be carried to a satisfactory conclusion.

The literature bearing directly on the fungoid parasites of diatoms other than the paper of Zopf is almost nil.

Cornu, in his monograph of the *Saprolegniæ* in the 'Annales des Sciences Naturelles' for 1872, describes under the name of *Olpidiopsis* several species of parasitic fungi infesting them. Some of these bear considerable resemblance in general characters and appearance to Zopf's *Ectrogella* and especially to that form of it which is described in the present paper. Pringsheim, in Jahrb. wiss. Bot., i. p. 289, describes a *Pythium* as attacking diatoms.

Carter (An. Nat. Hist., 2nd series, xvii. p. 101) describes a parasitic fungus which attacks *Spirogyra*, and which somewhat resembles *Ectrogella*, but which he expressly says is not found in diatoms.

Henfrey (Tr. Mic. Soc. (n.s.), vii. p. 25) describes a parasitic fungus which seems to be identical with Carter's.

There are two papers, by Currey and Rabenhorst respectively, on parasitic fungi attacking algæ (Mic. Jn., v. p. 211, and Rabenhorst, Alg., iii. p. 276) which I have been unable to consult in the original.

A. Fischer in Pringsheim's Jahrb., 1881-2, xiii. p. 286, extends and completes the description of the parasitic fungi treated of by Cornu (see *supra*) but does not note the occurrence of any of them in diatoms.

II.—*The Chromatic Curves of Microscope Objectives.*

By E. M. Nelson, F.R.M.S.

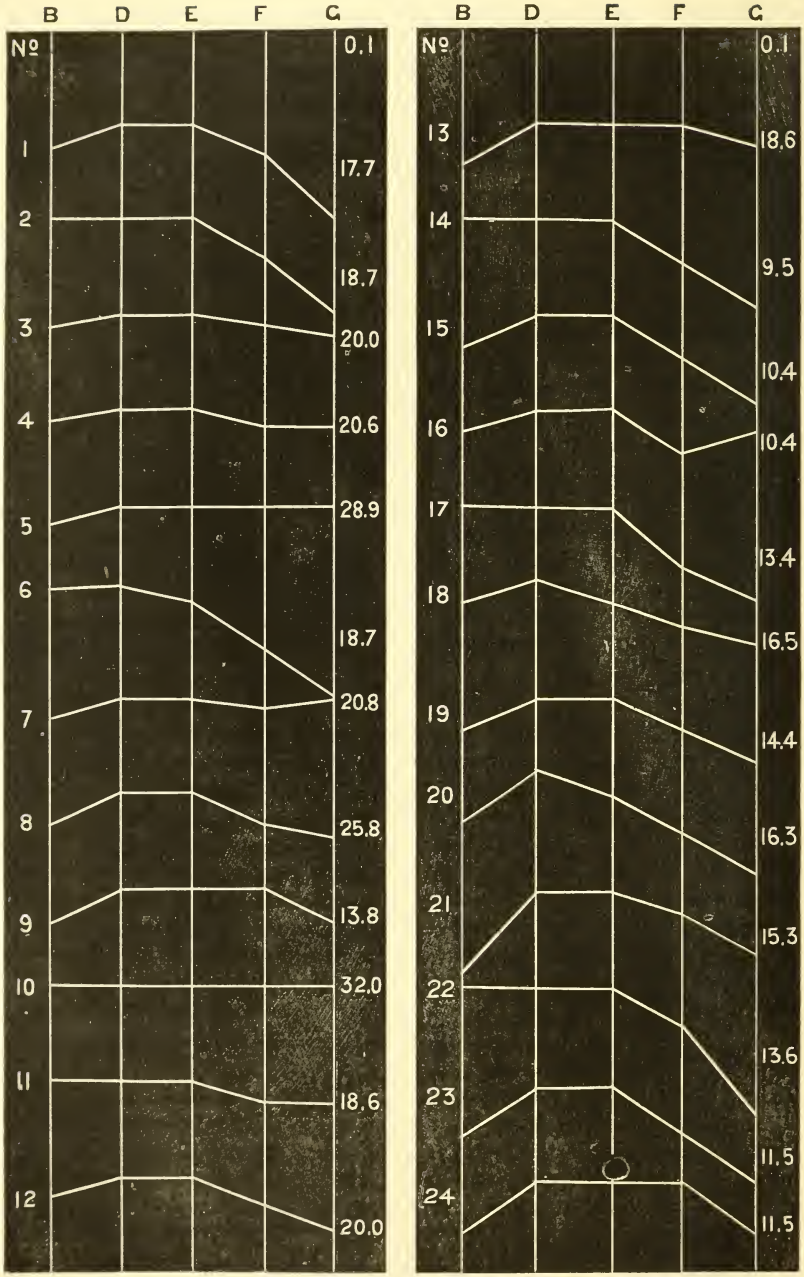
(*Read 15th February*, 1893.)

The achromatism of the Microscope objective is a subject which has received comparatively little attention except from the practical constructors of Microscope lenses. It is barely mentioned either in the text-books or in the journals of our Societies. The only work in our language, so far as I am aware, dealing with it at all at length is the English translation of Naegeli and Schwendener. The reason for this is not far to seek: excellent lenses often yield strongly coloured images, and lenses giving colourless images are usually defective in more important points. The presence or absence of colour is by itself no criterion of the excellence of either the Microscope or telescope objective. There are other points of greater importance which are liable to be overlooked. There is no question of colour correction in a reflecting telescope, its excellence depends on figure and centering, and these points are of equal importance in the dioptric telescope.

Now, spherical aberration is much more obtrusive in Microscope than in telescope objectives, because their apertures are vastly greater. An aperture of ·0625 N.A. is considered remarkable for a dioptric telescope, the usual aperture is half that amount. The new Greenwich telescope is to have ·0416 N.A., the greatest yet given to a large instrument. In achromatic days, as hinted above, objectives free from colour were as a rule to be avoided, because this freedom from colour was usually obtained at the expense of sharpness. There were two kinds of correction in vogue with achromatic lenses: one (A) left the image decidedly blue, and the other (B) red, and many excellent objectives were constructed on both these principles. The red kind of correction (B) must be divided into at least two, if not three, subdivisions, for there was (B i) an orange red which was bad, as a successful example of a lens exhibiting that colour of image had not been seen; all the fine glasses of the (B) type gave purple red (usually called claret) coloured images, and of these there were two groups, (B ii) the bluish purples, and (B iii) the reddish purples. Perhaps the finest glasses of old construction were those which gave images nearly resembling a solution of permanganate of potass and water, or the more homely damson-juice, in colour (B ii) and (B iii).

In selecting an objective the great desiderata were sharp and brilliant images, and these desiderata were usually accompanied by violent colours. It will be said that these colours are those of the secondary spectrum due to the irrationality of ordinary crowns and flints, but I think you will agree with me that there is something more than this when you examine some of the curves presently. You will notice that I have employed the past tense when speaking about

Fig. 1.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these lenses; my reasons for this are, first, the introduction of apochromatics, and secondly, the use of Jena glass. The conditions which obtained before this no longer hold good, for lenses free from colour are among the most brilliant and sharp objectives, neither is an orange or brick-dust red any longer a bar to fine definition. But as in achromatic days we have seen that freedom from colour was not the most desirable end to be sought for in a Microscope lens, so too in these apochromatic times we must not reject a lens on account of the presence of colour. We may well ask, if the removal of colour is not the object in an apochromatic, what do we gain by it? The answer is (*a*) an enlargement of the ratio of aperture to focus, (*b*) an increase of brilliancy with equal apertures. Taking (*b*) first, let us compare an ancient but well corrected 2/3 of ·3 N.A. with a modern apochromatic of the same aperture and power. We shall find that the apochromatic will give us, first, a more brilliant image on account of the more perfect concentration of light, and secondly, a more beautiful image on account of the removal of false colour; but will it show us anything more or define anything that we cannot see with the old lens?· Rigidly speaking the apochromatic might show the flagellum of a bacterium which the old achromatic would fail to do, but practically speaking little difference would be observed in this respect. Only a dilettante would search for the flagellum of a bacterium with a 2/3. Therefore we may say that the difference between the apochromatic and the achromatic is merely an æsthetic one, viz. that of beauty and brightness of image. With regard to (*a*) however, if we take an apochromatic 1/2 of ·65 N.A. where shall we find the old lens with which to compare it? The old 1/2 inches of 80° were over-powered by 25 to 50 per cent.—in fact they were 4/10 and 1/3, consequently they are out of court; but suppose we admit this largely diminished ratio in aperture, we shall find that a further reduction of 20° must be made in the aperture of the old lenses before the image is sufficiently cleared from fog to be suitable for comparison, assuming of course that full cones are employed in all cases.

We have here something entirely distinct and new. The microscopic world had never until the introduction of the apochromatic seen such a ratio of aperture to power. The previous alleged examples were, as lawyers would say, first, not true in fact, and secondly, if true in fact were failures.

Those observers who use the 16 mm. and 8 mm. apochromatics have a more æsthetically perfect lens than was formerly possible, but apart from this æstheticism and photography they have nothing that was not obtainable under the old conditions, but those who use the 24 mm. and 12 mm. apochromatics have entirely new conditions which were not before practical.

Until Prof. Abbe invented the apochromatic principle there was no method of reducing the spherical aberration for more than one

colour. Now as spherical aberration is greatly increased by reducing the focus while the aperture remains the same, objectives which had a high ratio of aperture to focus always gave images bathed in the coloured fog of the unreduced spherical aberration.

The whole history of the progress of optics may be termed that of the increase of the ratio of the aperture to focus.

Huyghens and Campani's telescopes had a N.A. of ·003, but the new equatorial at Greenwich will have ·0416 N.A., the greatest yet accomplished in a large dioptric instrument.

The great Dollond, however, made a small telescope of ·069 N.A.

In reflecting telescopes, as there is no spherical aberration to correct for dispersion, a very high ratio of aperture to focus has been reached. In Gregorians, an aperture as high as ·24 N.A. has been attained, and several of ·164 N.A. have been made, which gave excellent results.

Newtonians have been made of ·083 N.A., and those of ·0625 N.A. are quite common. We see, therefore, that a ratio of aperture to focus, which is not in the least out of the way in a reflector, is exceptional in a refractor. This digression with regard to telescopes is useful, because it emphasizes the fact that it is the unreduced spherical aberration owing to dispersion which has hitherto barred the way to the increase in the ratio of aperture to power, but which has been greatly lessened by Prof. Abbe's apochromatic system.

But to return to our subject. The statement that objects are seen with apochromatic lenses in their natural colours may become misleading, because the colours of microscopic objects depend largely on diffraction effects which are quite dissipated when magnifying power is used. The magnificent colour of a scale of a *Morpho Menelaus* quickly disappears with magnification, so does the colour of the resplendent diatom *Actinocyclus Ehrenbergii* alter and become less as the power is increased, quite independently of the chromatic aberration of the lens; whereas some of the finest apochromatics impart faint rose or pale brown colours to colourless objects. We now come to the practical investigation of the chromatic aberration of Microscope lenses. The method employed by Messrs. Naegeli and Schwendener is the usual one of covering up half the aperture of the objective, the remaining half of the lens acting as a prism. They also refer to Prof. Abbe's plan of passing oblique beams through the objective by means of stops placed at the back of the condenser. On experimenting with both these methods I find that half the objective plan is ineffectual, and the drawback with regard to the Abbe method was the great amount of spherical aberration in the condenser which prevented the central and marginal cones of light being focused on the object at the same instant. Far better results can, however, be now obtained by using Powell and Lealand's fluorite apochromatic condenser, owing to its aplanatism. But the method for your investigation to-night differs from either of these. By means of my

monochromatic light apparatus * I am able to fill the back lens of the apochromatic condenser with any light I please of an approximately uniform wave-length, and then by placing a delicate test object on the stage, and with a deep eye-piece, focal differences of rays of various wave-lengths can be directly determined; the size of the illuminating cone can be altered at pleasure, and beams of various obliquities used.

There are two methods of measuring the focal differences, (*a*) by means of the graduations of the fine-adjustment, (*b*) by receiving the image on a screen, and noting the differences in screen distance. When one focal difference is known, the other may be calculated. Thus let d be the difference of focus at the object side, or the movement by the fine-adjustment, and let D be the difference of focus at the image side, or difference of screen distance, and m the initial power of the objective, w being the screen distance, and assuming that w is large compared with D. Then †

$$D = \frac{d\,w^2}{f^2} = d\,m^2 \quad \text{and} \quad d = \frac{D\,f^2}{w^2} = \frac{D}{m^2}.$$

I have measured the foci for the lines B, D, E, F, and G of many various objectives both ancient and modern, and now submit for your inspection the curves of some of them which possess particular interest, drawn from those measurements (fig. 1).

But before discussing these curves let me point out some important points which bear on practical microscopy in connection with monochromatic illumination.

The ends in view with illumination by monochromatic light have been, speaking for myself—and I think it is also the generally received impression—(*a*) the increase of resolving power by means of illumination of the object by light of a shorter wave-length than usually employed, and (*b*) the removal of the secondary spectrum in achromatic lenses. But there has been a certain mystery respecting the effect of monochromatic illumination, the solution of which has not been clear. As it is a most important subject, I hope you will pardon me if it is dealt with at some length.

As stated previously,‡ the effect of shortening the wave-length was practically to add ·1 N.A. to the aperture of the objective mentioned. For if λ is the number of waves of light per inch, and N.A. the numerical aperture of the objective, then L the number of lines resolved per inch will be equal to $2\,\lambda$ (N.A.). As vision fails greatly in blue light, and glass is not transparent for very short waves, anything as high up as the G line is quite out of the question, so we must content ourselves with a wave-length lower down the spectrum. In practice, shortening the wave-length gives about

* Journal R.M.S., 1892, pl. I.

† Tom. cit., p. 341.

‡ Tom. cit., p. 446.

14 per cent. of increase of resolving power with medium and lower apertures, but with ·95 N.A. or over, the effect is greatly lessened (see Table). This being the case, why should monochromatic light be so serviceable, especially with wide-angled achromatics? We have seen that the presence of colour in an achromatic is no bar to definition and resolution. I have seen many old high-power achromatics which will show anything that apochromatics will. I believe Dr. Dallinger still has in his possession some old achromatics that will do so (the visibility of minute flagella, which probably depends on what we have termed the æstheticism of the image, should perhaps be excepted). It is the removal of the spherical aberration due to differences of colour caused by diffraction. This statement may not be very clear; an example will perhaps explain it. Let us examine an ordinary *P. angulatum* with a cheap 1/7 of ·8 N.A., the image will be what might have been expected; but under monochromatic illumination, even when that is not of a short wave-length, we obtain what we should not have expected, viz. a wonderfully sharp image, a something more than the mere removal of the outstanding colour; in brief, you would think that you were examining the object with a very wide-angled lens, but at the same time you would not notice any increase of resolving power. What I mean is that you would see none of the finer detail of the object which could only be resolved by a very wide angle, but the detail that you do see would appear as if it were being shown by a very wide-angled lens. These appearances are familiar to those who have worked with monochromatic light. Let us now consider the conditions we have when the object is seen with ordinary light, and say a rather small cone of illumination. With the lens of ·8 N.A., the six green spectra of the *P. angulatum* would appear in the peripheral zone of the objective, and the white dioptric beam would be seen in the centre of the lens. Therefore, we have by means of diffraction practically a monochromatic illumination in the outer peripheral zone of the lens (the red and orange being cut off at the edge of the lens, while the blue and green are left, but the blue is too weak to affect the image), and in the centre of the lens white light.

Now the perfection of the image consists in the exact union of these outer spectral beams with the central beam. But this exact union probably does not take place, because the spherical aberration of the objective is very likely not corrected for these two colours, viz. the green in the peripheral zone and that which most strongly affects the eye, viz. the orange-yellow in the centre. The moment monochromatic light is used the centre is made of the same colour as the periphery, and if that colour for which the lens is corrected be chosen, a magnificent image is the result. Those objects which bring the first order spectra well within the grip of the lens are not so much affected by monochromatic light, but it is the finer detail, the spectra of which would be at the periphery of the lens, which is

sharpened up by the use of monochromatic illumination. The *P. angulatum* in this respect forms an excellent example.

Some lenses fail altogether with blue light because the optician's aim has not been to correct the lens for the spherical aberration of the blue ray. The lens I am exhibiting to you this evening fails altogether with blue light. The apochromatics do not go off like this in the blue, at the same time they do not yield the results that might be expected from them. We find therefore that the idea of the use of monochromatic light for shortening the wave-length, and by that means obtaining a greater resolving power, must not be pressed too far, especially when speaking of both apochromatic and achromatic lenses as they are at the present time. (In addition to this, account must be taken of the fact that the eye fails in the blue light, not to mention the pain caused by its prolongued use.)

For visual purposes at least there are no expectations of any great advance with light of a wave-length much shorter than 1/50,000 in., or the blue green. What may be done photographically with a lens, made of material which is transparent to rays high up in the violet, and whose spherical aberration for those rays has been specially corrected, when used with plates made sensitive to such rays, we cannot say; but under existing conditions we must not look for a great percentage of gain (only 7 per cent. with a wave-length of 1/50,000 in., and 14 per cent. in table with low and medium powers). This testing by means of monochromatic blue light shows directly the quality of an objective for photographic purposes.

There are many lenses "corrected for photomicrography" which are all right so long as small cones are used, but directly any strain is placed upon the objective by a large cone the spherical aberration for the rays of short wave-length is instantly developed, It is here that a monochromatic yellow-green screen becomes of service because with specially prepared plates good photographs may be taken with almost any kind of lens.* Strictly speaking, the screen should be monochromatic for that special ray for which the optician has corrected the spherical aberration of the objective: this usually will be found to be the yellow green. I have been trying for some time past to find a monochromatic glass screen. With coloured gelatin films an excellent monochromatic screen may be obtained, but it is not so easy to match the gelatin in glass. I have however found two glasses † which answer the purpose very well, as you will be able to judge for yourselves by an examination of the image of the *P. angulatum* as shown with a cheap lens in the Microscope on the table.

* It is of interest to note that the screen may be placed either between the lamp flame and the back lens of the condenser or over the eye-piece. It should be remembered that all Prof. Abbe's diffraction experiments may be performed above the eye-piece, equally as well as at the back of the objective.

† Can be procured at Messrs. Baker's.

We will now pay our sole attention to the curves. They are drawn so as to represent the alteration in screen distance with light of different wave-lengths. The lenses are all focused with light E, the length of this vertical line to where the curve cuts it is supposed to be 10 in.* The curve for a non-achromatized lens would continuously slope downwards from left to right. The curve of an objective perfectly corrected for all colours would therefore be represented by a horizontal line, because the screen would remain at the same distance from the lens, viz. 10 in., with the other colours as with the green. This result is, you will observe, obtained with some of the apochromatics.

The ideal curve for an achromatic lens corrected for two colours, say D and F, and focused with light E, would slope downwards from B to D, it would then slope less from D to E, it would then rise a similar amount to F, so that F and D would have the same focus, and then finally it would slope away at G. The reason for a small dip at E is owing to the irrationality of the spectrum. Except for a slight over-correction, No. 4 represents an ideal achromatic.

The column marked O.I. indicates the ratio of aperture to power; it is the N.A. of the objective multiplied by 1000 and divided by the initial magnifying power of the objective.† This shows the efficiency of the objective from solely an optical standpoint: it can therefore appropriately be called "The Optical Index," or O.I.

If a Microscope is required to show all that a keen eye is able to appreciate then ·26 N.A. must be given to it for every 100 diameters of magnification.‡ If we limit the power of the eye-piece of such a Microscope to 10 then the objective must have ·26 N.A. for each 10 diameters of initial magnifying power. The optical index therefore for a theoretically perfect Microscope objective will be 26·0.

This gives a very convenient rule; for dropping the odd decimal we get the following:—The limit of combined power for best definition with any objective of any given aperture may be found by multiplying its N.A. by 400. Example:—The limit of power for best definition with a 2/3 in. of ·3 N.A. is 120 diameters. The converse rule may be stated thus:—The ideal N.A. for any objective whose *initial* power is known can be found by multiplying ·025 by that power. Example:—The ideal N.A. for a 1/2 of power 20 is ·025 × 20 = ·5 N.A. This ratio has not only been attained, but is surpassed by that most

* Note particularly *not proportional*. Thus in curve 2, line E, though actually 1 in., represents 10 in.; the line F, actually 1¼ in., represents 10¼ in., *not* 12½ *in. which it would do if it were proportional*. This remark applies to the *whole* diagram.

† In discussions with regard to the Microscope it is better to consider this ratio as one of aperture to *power*, instead of the usual ratio of aperture to *focus*, which is employed when speaking of telescopes and photographic lenses. The reason for this is, that the foci both of telescopes and photographic lenses can be easily and accurately determined, whereas it is the *power* and not the *focus* which can be easily and accurately measured in a Microscope objective.

‡ 'Ratio of Aperture to Power,' by E. M. Nelson. English Mechanic, xxxviii. (1883) No. 979.

excellent apochromatic 12 mm. of Zeiss which has a N.A. of ·66 or an optical index of 32·0. Referring to fig. 1, we find that No. 1 has an optical index of 17·7; it is an inch by Andrew Ross more than fifty years old. (Please note particularly that the curve of this lens as well as those of the next four is enlarged three times, and a 3/4 cone is employed throughout except in No. 23 where a full cone is used.) It shows over-correction in the red, but the focus for D is the same as for E, but as we proceed to G the under-correction increases rapidly. It is a good objective, correction (B ii). No. 2 is a modern American inch with the slightly larger optical index of 18·7; this has been better corrected for rays lower down the spectrum, but it is under-corrected in the violet; this is also a (B ii) glass, and its performance is brilliant.

No. 3 is a semi-apochromatic, its power is somewhat less than an inch, but it has a higher optical index of 20·0. You will notice that it is very well corrected throughout the spectrum, its image is nearly colourless (B iii slight), it photographs well, and is an excellent object-glass.

No. 4 is an old inch by J. H. Dallmeyer, consisting of two doublets; it is the most achromatic of any old lens I have met with (B ii slight), and it has the fairly high optical index of 20·6. No. 5 is an apochromatic as may be seen at once, there is a mere trifle of over-correction in the red, it is a splendid objective, with the high optical index of nearly 30. (The curves of the next six objectives are enlarged twice.)

No. 6 is an English achromatic 2/3 (1875), it is well corrected for the lines B D and E, and is correspondingly under-corrected for F and G. It has a bluish correction (A), and is a sharp lens, but will not photograph.

No. 7 is a semi-apochromatic 2/3, and is a sharp lens, practically colourless, which will photograph; its optical index is higher than that of the previous achromatic, being nearly 21.

Nos. 8 and 9 are the same objective, the aperture of No. 9 being reduced by a stop. This lens is a 1/2 of 80° by Wenham, but in reality it is a 4/10 with the high optical index of nearly 26, correction (B iii). This lens has considerable spherical aberration, but when it is stopped down to 60° it performs admirably; it will not photograph with full aperture, as it is slightly under-corrected for the F line.

No. 10 is a splendid apochromatic 1/2 with the enormous optical index of 32·0; notwithstanding no alteration in focus can be detected throughout the spectrum. No. 11 is a fine semi-apochromatic 1/3; it exhibits a strong correction in the violet (B iii), and it will photograph. (All the curves are now the actual curves of the objectives.) No. 12 is a fine English achromatic 4/10 by Powell (1875); it has a triple front and back and a double middle; its optical index is fairly high, viz. 20·0, and it is a well-corrected lens (B iii). It is typical of the best achievement in achromatic days. No. 13 is a very im-

portant curve; it will be seen at once that it is that of a well-corrected objective; it is a semi-apochromatic 1/4 with the high optical index of 18·6 (23·2 being the highest optical index of an apochromatic 1/4 as yet made); it is slightly over-corrected in the red, but is well corrected in the blue; this lens will probably be a good photographer, visually it is very sharp (B iii).

No. 14 is the curve of a very old 1/4 by Andrew Ross (1835), consisting of three doublets; the optical index is only 9·5, correction (A slight). No. 15 is a 1/4 by Powell, of 1842; the optical index is a trifle higher, and the correction (B iii). No. 16 is a 1/4 by Andrew Ross, 1847, which, like the preceding, has three doublets, and does not show much colour (B iii slight). No. 17 is a single-fronted 1/4, optical index still increasing. No. 18 a 1/4 by Powell (1875), triple front and back and double middle, optical index enlarged (B ii). No. 19 an early cheap Student's English 1/4, with single front and no correction collar; it has a lower optical index, and a correction (B iii). No. 20, an American 1/5, about eight years old, violently coloured (B ii), but otherwise well corrected, with a higher optical index. No. 21, a Tolles 1/4, really a 1/6; this is a curiously corrected objective, giving tolerably sharp definition, with a red colour (B i), optical index somewhat lower than the preceding. No. 22, a Hartnack 1/7 (1867), a blue lens (A). Nos. 23 and 24 are the curves of the same objective, viz. a cheap semi-apochromatic 1/7 (B iii). No 23 is the curve with a full cone of illumination, and 24 that with a 3/4 cone. The optical index is low, being the same as that of the dry apochromatic 1/8, but the images it yields are scarcely inferior to that lens.

The curve of Powell's very fine achromatic 1/4 is not given, because it is a straight line, and would therefore be only a repetition of No. 10; its optical index is 23·2.

We will next observe the variations in the curves of an achromat, semi-apochromat, and apochromat owing to different corrections of the eye-piece. An achromatic 4/10 (No. 12, fig. 1) has the flattest curve, with the Huyghenian eye-piece. With an under-corrected eye-piece (single lens) the curve remains the same in the blue, but it is a trifle more bent in the red. With an over-corrected eye-piece (compensating) the steepness of the curve is slightly increased, both in the red and in blue and violet.

A semi-apochromatic 1/3 (No. 11) has the flattest curve with the over-corrected compensating eye-piece; with a Huyghenian it is a trifle more bent, and with an under-corrected single lens it is a good deal more bent in the B and G lines.

An apochromatic 1/2 (No. 10) shows no measurable difference between the compensating and the Huyghenian eye-pieces; but when an under-corrected eye-piece is used, there is a slight under-correction noticeable throughout the spectrum.

Most of the above differences are too slight to be represented by a drawn curve, unless much amplified.

As that part of the table on the fly-leaf of this Journal entitled "Limit of Resolving Power" is based on the assumption that the object is illuminated by a single beam of utmost obliquity in one azimuth, and as such illumination should only be used for the special resolution of very fine lines ruled on glass, such as Nobert's or Fasoldt's bands; further, as the resolution of a high number of lines with a single oblique beam in one azimuth is, as I have frequently pointed out, no criterion of the quality of an objective, because only the outer zone of the objective is utilized, the practical value of that part of the table is somewhat diminished.

The following table is, however, constructed to meet the every-day wants of the practical microscopist. It gives the resolving power of first-class objectives with a 3/4 cone of direct illumination, both with white and blue light. For white light a line lower down the spectrum between D and E has been selected, because it more nearly represents the light which makes the strongest impression on the retina. For monochromatic light a line is taken a little higher up than F. It will be noticed that photography is also classed with this wave-length; from practical experience I am convinced that, with ordinary photographic methods, light near the line H has very little influence on a photomicrograph. Glass is not very transparent to rays of a short wave-length, and when we consider that the light has often to pass through, besides the slip, cover-glass, mounting medium, oil-immersion fluid, 19 lenses without counting the bull's-eye (which I seldom use), it is not to be expected that an ultra-violet light should have much potency.

The number of lines resolvable with a 3/4 cone of direct illumination can be calculated by the formula $\frac{3\lambda}{2}$ (N.A.), λ being the number of waves per inch. If we take, therefore, a wave-length of 1/46,666 in. ($= 0{\cdot}5443\,\mu$) for the white light, and of 1/53,333 in. ($= 0{\cdot}4762\,\mu$) for the monochromatic blue light, $3\lambda / 2$ will equal 70,000 and 80,000 respectively. All then we have to do is to multiply the (N.A.) by 70,000 for white light, and 80,000 for monochromatic blue light.

Great accuracy is not needed in choosing the line, because the retina is not affected by a few hundred waves more or less, and probably all persons are not influenced alike. It will be observed that the resolving powers for blue light are not carried on with apertures greater than 0·8 N.A. The reason for this is that its effect here ceases; further, results obtained with higher apertures are hardly up to the values given under white light, even when blue-green light is used.

In my former paper, already alluded to, the advantages derived from the use of monochromatic blue light were stated to be owing to the shortening of the wave-length; this statement, although quite correct in theory, must not be pushed too far, especially with higher apertures. It makes a difference of about 14 per cent. in the case of low apertures, but beyond those of 0·9 N.A. its influence in increas-

ing resolution is so small as to be hardly worth taking into account. What it does effect is the sharpening and clearing of detail already resolved, as I have attempted to explain above.

With all apertures it will be found that blue-green light yields the best results. We see, therefore, that blue-green monochromatic illumination with low and medium apertures both increases resolution and sharpens up the image, but with high apertures it merely sharpens the image.

A great deal has been said with regard to resolution by photographic methods, viz. that because photography utilizes rays of a very short wave-length, therefore a far greater amount of resolution is secured by its use, and that many objects have been discovered by photography that were invisible by ordinary vision. I cannot endorse this statement that a greater amount of resolution is possible by photographic methods, for the reason stated above, viz. that the short blue waves are weakened in passing through the glass; it is light of a longer wave-length that in reality impresses the image on the plate. In the writings on this subject a great deal of inexact language is made use of, such as "monochromatic blue light," for when you inquire how was this obtained? you are told by means of an ammonio-sulphate of copper cell. As this cell passes some red and green light, it is inaccurate to term the light monochromatic.* In such a case it is the green or blue-green light which impresses the plate. It is quite out of the question that light as short as $\cdot 4\ \mu$ has any effect at all with wide angles. In practice on the most delicate diatom markings I have found scarcely any increase of resolution with wide apertures by photographic methods.

Next, with regard to the discovery of objects by means of photography. These discoveries lie among such objects as flagella, which are visible solely on account of differences of light and shade. Photography accentuates this difference by "time impression," a case precisely analogous to the photography of very minute stars which are quite invisible with the telescope they were photographed with. "Time impression" means that with a photographic plate the effect of a very weak light is cumulative, whereas on the retina a very weak light either stimulates the retina or it does not, therefore accumulation goes for nothing.

For example, a very fine jet of water may be issuing from an orifice; a person with not very good sight might not be able to perceive the water, but let this tiny stream accumulate in a cistern for a week then he would be almost blind if he could not see it. This is the way flagella and such like objects are made visible by photography. The more unskilled the observer, and the more uncritical the method of his work, the more objects will he discover by photographic means.

* An excellent test for monochromatic light is the examination of the brilliant spectrum at the back of an objective of medium power obtained by illuminating a coarse diatom such as a *Pinnularia* with an oblique beam. If an ammonio-sulphate of copper cell is interposed green and some red will still be seen, which proves that the illumination is not *monochromatic*.

It is more than probable that of all objects photographically discovered, there is not one which cannot be visually demonstrated with a far lower power when the Microscope is critically used.

Table of Resolving Powers in Lines to an Inch with 3/4 Cone of Direct Illumination.

N.A.	White Light. Between lines D and E 46,666 waves per inch.	Monochromatic Blue Light and Photography. Near line F 53,333 waves per inch.
0·1	7,000	8,000
0·2	14,000	16,000
0·3	21,000	24,000
0·4	28,000	32,000
0·5	35,000	40,000
0·6	42,000	48,000
0·7	49,000	56,000
0·8	56,000	64,000
0·9	63,000	
1·0	70,000	The same as for
1·1	77,003	white light.
1·2	84,000	
1·3	91,000	
1·4	98,000	
1·5	105,000	
1·6	112,000	

The above table agrees remarkably well with results actually obtained with the best lenses, and to show that this is so, the following table gives the actual resolutions made on diatoms in balsam with a 3/4 cone from a Powell fluorite apochromatic condenser (1/4 of 0·95 N.A.).

Objective.	O.I.	N.A.	White Light.	Blue Light.
Apochromatic 1 in. ..	28·9	·32	22,000	25,000
1. Achromatic 4/10 (1875)	20·0	·64	40,000 strong	49,000
2. Apochromatic 1/2 ..	32·0	·66	46,000	53,500
3. Semi-apochromatic 1/4	18·6	·71	53,500	60,000 barely
Achromatic 1/4 (1875)	16·5	·79	53,000 barely	60,000 barely
Semi-apochromatic 1/7	11·5	·86	60,000	65,000
4. Achromatic 1/5	16·3	·88	60,000	65,000 barely
Apochromatic 1/4 ..	23·2	·95	65,000	—
5. Semi-apochromatic 1/12	9·7	1·26	90,000 barely	—
6. Apochromatic 1/8	17·0	1·43	94,000	—

1. Would resolve probably 42,000 with white light (construction same as achromatic 1/4, viz. triple front and back, double middle).
2. A very fine lens.
3. A little more than 3/4 cone used; this lens is a very strong resolver, and stands blue light even better than some apochromatics.
4. A fine example of an achromatic by Gundlach.
5. Will not resolve the *Nitzschia curvula* 90,000.
6. Resolves *Amphipleura pellucida* 93,000–95,000. Less than 3/4 cone used.

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.†

Development of Elements of Nervous System.‡—Prof. A. Kölliker gives, in consideration of the present discussion on this subject, a summary account of his own views:—

(1) The first nerve-fibres which appear in the tail-fringe of Batrachian larvæ are all non-nucleated, very fine, branched filaments.

(2) In time there appear on the filaments first a few, widely separated nuclei, which in time increase in number; these are, for various reasons, to be regarded as mesodermal cells deposited from the outside.

(3) In fine medullated fibres there appear at the points of constriction very fine, non-nucleated, branched fibrils which are branches of the axis-cylinder; these in time form fresh rich ramifications which are nucleated at points; this, perhaps, shows in the most striking way that nerve-fibres are not derived from rows of cells.

(4) All the peripheral larger motor nerve-trunks of Birds and Mammals are formed of bundles of very fine non-medullated nerve-fibrils which have no nuclei or cells and of an investment of mesodermal cells which gradually grows inwards. Prof. Kölliker has lately shown that the same is true of the sensory cephalic nerves of young embryos. This fact, again, shows clearly that these elements are not formed by the concrescence of rows of cells.

(5) Further, the central nerve-fibres first appear without nuclei or

* 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.

‡ Verhandl. Anat. Gesell., 1892, pp. 76–8.

cells on the surface of the spinal cord or brain, and in the interior of the latter; it is only later that a nucleated and cell-containing tissue grows into the white substance.

(6) As the central nerve-fibres have no nucleated sheaths it is clear that Schwann's cells do not form the axis-cylinder and medulla.

(7) The outgrowth of nerve-cells (neuroblasts) into the axis-cylinder has been seen, and is not difficult to demonstrate.

(8) The method of Golgi shows that in young embryos the nervous processes are formed from cells, which belong partly to the medullary plate and the adjoining ectoderm, and partly to the peripheral ectoderm.

(9) All the very fine peripherally distributed nerve-fibres such as those of the cornea and others have no nuclei, and show us that the axis-cylinder may innervate a wide area by simple longitudinal growth without any part being taken by foreign cells. The same is shown by Golgi's so-called sensory cells of the second order.

(10) Finally, the processes of nerve-regeneration show that this is effected solely by the axis-cylinder.

(11) Prof. Kölliker now finds that the cells which he thought formed olfactory fibres are secondary and mesodermal structures.

(12) He concludes that all nerve-fibres are direct processes of nerve-cells.

Development of Optic Nerves of Vertebrates.*—Mr. R. Assheton points out that there are now two very distinct theories as to the origin of the optic nerve; that which is generally held in this country is that which was thus expressed by Balfour:—"The fibres of the optic nerves are derived from a differentiation of the epithelial cells of which the nerve is at first formed;" in Germany, however, His, W. Müller, Mihalkovics, and Kölliker agree that nerve-fibres are outgrowths from nerve-cells, and that sensory fibres of sense-organs grow inwards from the sensory epithelium of the sense-organ to the central nervous system. The author has studied the development of the optic nerve in the frog and in the chick, and he comes to the conclusion that the optic stalk takes no part in the formation of the nervous parts of the organ of sight. This optic stalk becomes broken down and the cells composing it are separated from one another, partly by the mechanical stretching due to the growth of the optic nerve, and partly by the growth in between the several cells of the nerve-fibres. The nerve-fibres of the optic lie along the posterior border of the stalk, and are at first entirely outside it; but, on the breaking down of the stalk, some of the nerve-fibres grow in between the cells. The great majority of fibres forming the optic nerve arise as outgrowths from cells in the retina, and grow towards and into the brain. Cajal has discovered certain fibres which would seem to grow from the central nervous system to the retina, but these Mr. Assheton has not been able to find. The nerve-fibres pass over the ventral edge of the optic cup and thereby cause the formation of the choroidal fissure; at this point there is no proliferation of cells. The author remarks that he has never seen the suggestion that the fissure represents a stage in the evolution of the eye, being, of course, ignorant at the time of writing that Prof. Bütschli was about to make a

* Quart. Journ. Micr. Sci., xxxiv. (1892) pp. 85-104 (2 pls.).

suggestion on the subject.* Whatever was the first origin of the eyes of Vertebrates it is clear that they were of myelonic origin and much more deeply placed than at present in adult Vertebrates, and the eye would not become a cup till the lens was formed. The passage of the nerve-fibres over one part of the edge of the area would prevent the growth of the edge at that point, and consequently a gap would be left; this gap is the choroidal fissure, which was probably permanently open during a certain stage in the evolution of the Vertebrate eye, and which has only secondarily been used as a means of ingress for the mesoblastic tissues.

Origin of Vascular Germs in the Chick.†—M. L. Vialleton brings evidence to show that the vascular germs of the Chick arise in the parablast, independently of the mesoderm. To the objection that there may have been migration he answers that if the germs could thus migrate they would often be found outside the terminal sinus, whereas this is very rare, and he has only seen it once. Further, the migration of a relatively large mass in a plasmodium would not be easy; if it is suggested that it was not effected across the parablast, but between it and the ectoderm, an explanation would have to be given of the spherical form of the germ. On the whole, then, the author is in favour of the parablastic origin of the vascular germs, and he hopes that the presence of these germs outside the vascular area will do something to resolve the difficult question of their origin.

Axial and Lateral Metamerism of the Head in Embryos of Birds.‡—Herr N. Goronowitsch finds in bird embryos with six metameres the first rudiments of the so-called "ganglionic ridges" (*Ganglienleisten*). They are formed from lateral outgrowths of upright dorsal portions of the medullary plate, but perhaps ectoderm apart from the medullary plate helps. The ganglionic ridges are most marked in embryos with eight metameres, and in this (primary) state they belong to the region of thalamencephalon and mesencephalon. In embryos with nine metameres the ridges have begun to divide up into isolated cells. These become identified with cells of the axial mesoderm. They have nothing to do with the development of nerves or ganglia.

The author proceeds to describe the origin of the secondary and tertiary ridges, which belong to the posterior region of the medulla oblongata. They are much weaker than the primary ridges. The fact that ectoderm shares in forming the mesoderm is emphasized. It has been believed that a dorsal outgrowth of the brain extends laterally from the axial mesoderm, reaches the ectoderm, and fuses with it (branchial sense-organs), but the outgrowth is genetically complex. The dorsal portion is formed from ectoderm and from the medullary plate, the middle part is a differentiation of axial mesoderm, the distal part is formed from the middle plate of mesoderm and from the mesoderm of ectodermic origin. The development of the tertiary ridges also shows that the lateral metameres are formed dorsally from the elements of the ridges, and distally from the elements of the axial mesoderm.

The development of the trigeminus and its ganglion occurs without

* See this Journal, 1892, pp. 775 and 6.

† Anat. Anzeig., vii. (1892) pp. 624–7.

‡ Tom. cit., pp. 454–64.

any help from the so-called ganglionic ridge. In the development of a nerve two facts must be clearly distinguished: the development of the tract of nerve-carrying tissue (which in the case of the bird's trigeminus is purely mesodermic), and the proper development of the nerve which begins with the appearance of the neuroblasts. The author's views may be generally expressed as a combination of those of Goette with those of His.

Maturation of Amphibian Ova and Fertilization of Immature Ova of Triton.*—Prof. G. Born has extended O. Schultze's observations on the maturation of Amphibian ova. He chiefly studied *Triton tæniatus*. He finds that the peculiar coil of transverse threads in the ripening ovum arises directly from the chromatin framework, and describes the transformation in detail. This is difficult to follow without figures, which will be published in a future memoir.

In the ripest ovarian ova the nuclear spindle of the first polar body was almost complete; in the ova from the visceral cavity the spindle lay tangentially under the surface, and the chromosomata were dividing into loops; in the oviducal ova with firm spherical envelopes the first polar body had been extruded; in the uterine ova the second spindle was complete. The author proves that all the oviducal ova and even those from the visceral cavity are, under certain conditions, capable of being fertilized and of development. From a few of the visceral ova Born reared morulæ, from distal oviducal ova normal larvæ.

Fertilization of Axolotl Ovum.†—Herr R. Fick finds that the middle portion of the spermatozoon gives rise to an attraction-sphere. No attraction-sphere was observed in association with the female pronucleus, but the two attraction-spheres of the first segmentation spindle seem to arise from the division of that associated with the spermatozoon. Sometimes as many as nine spermatozoa were found in the ovum.

Development of Endothelium of Heart of Amphibia.‡—M. V. Roudnev has chiefly studied embryos of *Rana temporaria*. He finds that, in the region of the pharynx, the endoderm forms a layer made up of cylindrical cells, which do not take any part in the formation of the heart. The vitelline mass, which has the character of a primitive endoderm, and which gives off whole layers in the region of the heart, at first nourishes the embryo directly, and next plays the part of a formative element of the blood. In the latter case it is a vitello-vascular layer, and it is from this last that there is formed the endothelium of the heart, of the veins, and of the aortic arches. The author thinks it is of importance to distinguish between the paired and unpaired types of formation of the Vertebrate heart.

Multiple and Partial Development in Amphioxus.§—Mr. E. B. Wilson finds that twin and double embryos can be produced in great numbers and with perfect ease by shaking apart the blastomeres of the two-celled stage. A normal blastula is formed by each, but of half the usual size, and so it is also with the gastrula. If the four blastomeres

* Anat. Anzeig., vii. (1892) pp. 772–81 (1 fig.) and 803–11.
† Tom. cit., pp. 818–21.
‡ Congrès Internat. de Zoologie, II. i. (1892) pp. 101-3.
§ Anat. Anzeig., vii. (1892) pp. 732–40 (11 figs.).

of the four-celled stage be completely isolated, each may give rise to a dwarf blastula, gastrula, and oval free-swimming embryo, of one-fourth the normal size. If the same stage fall into two pairs of cells, each pair forms an embryo of half the normal size. If the four blastomeres be imperfectly separated, three types of gastrulæ arise:—double embryos, triple embryos (one twice the size of the other two), and quadruple embryos (each one-fourth of the normal size). It seems likely that the isolated blastomere of the eight-celled stage is incapable of producing a gastrula, and that this is due to qualitative rather than to quantitative limitations is suggested by the developmental vigour of these one-eighth embryos, and by the fact that under certain conditions (from two- or four-celled stages by fission or breakage of a blastomere) minute gastrulæ are produced which are even less than one-eighth of the normal size.

In the normal segmentation, the fourth cleavage is not strictly meridional and radial, as Hatschek described, but is either (1) bilaterally symmetrical with reference to the first cleavage-plane (and very like that of Ascidians), or rarely (2) approaches the radial form, or most rarely (3) is of the true spiral type found in Annelids and Molluscs.

The cleavage of a completely isolated blastomere of the two-celled or four-celled stage is not a half-cleavage, but agrees essentially with that of a complete normal ovum. The development of the isolated unit is transformed from the beginning, and thus differs from that described by Roux for similar cases in the frog and by Driesch for the sea-urchin, for in both of these the development at first agrees with that of a normal embryo-half, and only later gives rise to a perfect embryo by a process which may be provisionally called "regeneration."

Phylogeny of Mammalian Teeth.*—Dr. C. Röse notices that various investigators had hinted at his theory of the origin of Mammalian molars by fusion of simple conical teeth. Giebel (1856), Gaudry (1878), Magitot (1883), and Dybowsky (1889) are noted. He points out that the general idea is thus neither original to Kükenthal nor to himself. In support of the coalescence theory he marshals numerous arguments, most of which are or have been noticed in this Journal in recording Röse's concrete researches.

History and Homologies of Human Molar Cusps.†—Prof. H. F. Osborn reviews the contributions of A. Fleischmann, J. Taeker, and C. Röse, and maintains the theory previously propounded by Cope and by himself. The primitive form of mammalian molar was a single cone, to which all the other cusps have been successively added. The protocone is invariably the anterior lateral (antero-external) cusp in the lower molars, and the anterior lingual (antero-internal) cusp in the upper molars.

Beginning with a single-fanged conical reptilian tooth, such as persists in Cetacea, Osborn finds the first departure towards a development of lateral cusps in the Triassic *Dromotherium*, the second in the contemporary *Microconodon*, the third in the Jurassic *Spalacotherium*, the fourth in the Jurassic *Amphitherium*, in which are seen the three cusps of the primitive triangle and the first cusp of the talon. In *Miacis*

* Biol. Centralbl., xii. (1892) pp. 624–38.
† Anat. Anzeig., vii. (1892) pp. 740–9 (3 figs.).

of the lower Eocene the primitive anterior portion (trigonid) of the crown was reduced to the level of the posterior portion (talonid) while retaining all its cusps. The oldest monkey or Lemur known—*Anaptomorphus*—illustrates the loss of the antero-internal cusp or paraconid. This accounts for the history of all the cusps in the human lower molar. "Thus, in the rich series of Mesozoic and lower Eocene mammals we can observe the actual rise, succession, and decline of all the six cusps, and do not require any new hypothesis to explain their appearance."

Rudiments of Teeth in Manis.*—Dr. C. Röse has found, in studying Prof. Max Weber's preparations of *Manis* embryos, a dental ridge (*Zahnleiste*) in the upper jaw, and even rudiments of teeth in the lower jaw. These rudiments are represented by a club-shaped swelling of the dental ridge and soon disappear.

Dentition of Marsupials.†—Dr. C. Röse maintains that the development of the teeth in Marsupials is essentially like that in other Mammals. The first stage is a ridge of epithelium which grows into the mesoderm. On this appear the rudiments of the first set. In *Didelphys* these are the incisors, the canine, two premolars, and the first molar. These are constricted off from the ridge which grows inwards and backwards. The posterior molars arise, as Röse has described in man, by the lateral extension of the dental ridge. But while in man the supplementary ridge forms as many replacement teeth as there are of the first set, from that of Marsupials there usually arises only the last premolar. It is more than likely, however, that the last incisors of *Perameles*, *Macropus*, and *Phalangista* are formed from the replacement ridge, i. e. belong to the second set. The last premolar may slip into a gap in the first series (*Didelphys*, *Perameles Doreganus*, *Belideus bidens*, *Phalangista Cookii*, and *Myrmecobius*), or it may replace the last premolar of the first set (*Phalangista*, *Macropus lugens*, *M. giganteus*, &c.). With the exception, then, of the last premolar, and possibly of the last upper incisor of some species, the teeth of Marsupials correspond to permanent milk-teeth. In the reduction of dental replacement the Marsupials seem almost to have overshot the mark. "Sie haben sich in eine Sackgasse verirrt, aus der kein Rückweg möglich ist."

Röse seeks to confirm his theory that premolars and molars arise from the fusion of several simple teeth. In the extinct *Triacanthodon* the premolars are quite like the molars; the inferior premolar of *Macropus lugens* is still triconodont, the upper one is in transition to the tritubercular type; in *M. giganteus* the premolars are tritubercular; and so on.

Dental Ridge and "Egg-teeth" in Sauropsida.‡—Dr. C. Röse finds in embryos of *Sterna Wilsoni* a distinct dental ridge (*Zahnleiste*), but no dental rudiments. A slight hint of papillæ is due to a folding of the horny epithelium as the beak becomes curved; and probably this is true also of the well-known papillæ of certain parrots. In *Chelone Midas* the dental ridge was again found, but nothing more. The true "egg-tooth" found in reptiles with parchment-like egg-shells is a dentine tooth situated on the premaxilla, and is quite distinct from the knob

* Anat. Anzeig., vii. (1892) pp. 618–22 (4 figs.).
† Tom. cit., pp. 639–50, 693–707 (23 figs.).
‡ Tom. cit., pp. 748–58 (14 figs.).

(*Eischwiele*) found in all birds, in crocodiles and tortoises, and in *Trachydosaurus*, for this is merely a horny epithelial organ.

Life-history and Development of Food and other Fishes.*—Prof. W. C. M'Intosh gives us another series of his interesting contributions to this important subject. He begins with a number of details as to young Pleuronectids, and after describing an unknown post-larval form, proceeds to describe the eggs of the Halibut, which have hitherto escaped detection, when ripe; they were obtained by Mr. Holt at Grimsby. A few unfertilized eggs of the Green Cod have been observed. The eggs of the Pollock and Torsk are next discussed, and they are followed by some notes on the development of *Arnoglossus megastoma*. Among the remaining subjects on which Prof. M'Intosh has notes are the development of the Brill and the eggs of *Lophius*.

Ovary and Intra-Ovarian Egg of Teleosteans.†—Mr. W. L. Calderwood, who has examined the ovaries of eleven species of Teleosteans, has most complete series of sections of the ovaries of the common dab (*Pleuronectes limanda*) and the hake (*Merluccius vulgaris*). It would appear that, in all ripening ovaries, ova for three consecutive spawning periods are present, and the ova may, therefore, be spoken of as great, small, and minute. These are described in order.

Eggs and Early Stages of Rhombus maximus.‡—Mr. E. W. L. Holt has been able to make some observations on the early stages of the Turbot. The usual diameter of the egg is 1·01 mm., and the oil-globule is nearly always ·21 mm. The yolk is colourless and homogeneous; the markings of the zone form an open network of no regular pattern. The few larvæ which were successfully hatched out lived but a few days; there is a general tendency in the Turbot's egg to sink sooner or later after fertilization, and it is prophesied that the successful culture of a pelagic ovum which assumes a demersal nature at an uncertain period will be difficult.

The most peculiar feature of young turbot is the cephalic armature, and Mr. Holt points out the interest of a Pleuronectid passing through a stage in which its cephalic armature is as powerful as, and for the most part homologous with, that of a Percoid or Scorpænoid.

β. Histology.

Invisibility of Living Nuclear Structures.§—Prof. W. Flemming discusses several cases in which living cells and nuclei show almost no structure, though that becomes evident enough after death or after simple technique. Such are the spermatocytes of Amphibia, the nuclei of the so-called poison-glands of the skin of Urodela, the nuclei of the salivary cells of *Chironomus plumosus*, the germinal vesicles of the ovarian ova of Ascidians, and others. But as the invisible structure is readily made manifest when the elements are killed and treated with simple reagents, the constancy of the observed phenomena is surely an argument against regarding post-mortem appearances as artificial.

* Tenth Ann. Rep. of the Fishery Board for Scotland, 1892, pp. 273–322 (4 pls.).
† Journ. Marine Biol. Assoc., ii. (1892) pp. 298–312 (2 pls.).
‡ Tom. cit., pp. 399–404.
§ Anat. Anzeig., vii. (1892) pp. 758–64.

Chromatin of Sympathetic Ganglia.*—Dr. F. Vas finds that the chromatin of the sympathetic nerve-cells has a definite structure, that its development keeps pace with that of the organism as a whole and with that of the nerve-cells in particular, that the associated pigment expresses a specific property of individual species, and that in man the chromatin is partly destroyed in old age. The stimulated cell differs from the unstimulated in several features, especially in the enlargement of the nucleus and its movement towards the periphery.

Blood of Amphibia.†—Herr M. C. Dekhuyzen finds five distinct kinds of cells in the blood-plasma. The distinctive characters of the adult cells appear only gradually, so that there are unexpectedly great differences between the youngest and the fully developed stages. In analogy with Löwit's nomenclature he uses the ending "blast" for young forms, and "cyt" for those which are adult. He distinguishes (1) hæmoglobin-free erythroblasts, and erythrocytes or chromocytes, known by their nucleolus; (2) thromboblasts and thrombocytes, as the "spindles" of Eberth and Schimmelbusch may be called; they are known by their mitochrom; (3) finely granular leucoblasts or leucocytes, known by their pseudopodia and by the tendency of the nucleus to polymorphism and polymerism: (4) eosinophilous leucoblasts (with β-granulations) and leucocytes (with α-granulations), known by their granulations and the same nuclear characters as (3); (5) klasmatoblasts and klasmatocytes, known by their granules. The various characters of these cells are treated in detail, and it is urged that there is no evidence of any intermediate stages between the different kinds.

Cerebro-Spinal Ganglia.‡—According to Prof. A. Van Gehuchten the application of the new methods of treating nerve-cells has resulted in showing that the nerve-cells of the spinal ganglia of most Fishes are opposito-bipolar; each pole is continuous with the cylinder-axis of a nerve-fibre, one of which passes to the medulla and the other to the periphery. The nerve-cells of the spinal ganglia of other Vertebrates are, in the adult, all unipolar; the single prolongation bifurcates, at a varying distance from the cell, into a central and a peripheral prolongation. In Cyclostomatous Fishes there are in the spinal ganglia of the adult not only both the above kinds of cells, but also others which are intermediate; and this shows that a bipolar may be transformed into a unipolar cell. The same fact is observed in the embryos of Mammals, Birds, and Reptiles. At a certain period in development all the nerve-cells of the spinal ganglia are opposito-bipolar, as in Fishes; in the course of development the form of the cell is modified, and the bipolar cell becomes unipolar. The morphological difference, therefore, which exists between the spinal ganglia of Fishes and other Vertebrates is more apparent than real; the lower forms retain permanently a condition which is transient in the higher.

In all Vertebrates, then, the spinal ganglia have the same significance; the cells which form them give rise, in one way or another, to two prolongations which become the cylinder-axes of two nerve-fibres.

* Arch. f. Mikr. Anat., xl. (1892) pp. 375–89 (1 pl.).
† Verhandl. Anat. Gesell., 1892, pp. 90–103 (1 pl.).
‡ Bull. Acad. Roy. Belgique, lxii. (1892) pp. 117–54 (11 figs.).

In all Vertebrates one of the fibres is central and the other peripheral; moreover, in a large number of cases the central prolongation is more delicate than the peripheral. The spinal ganglia of Vertebrates ought, then, to be considered as nuclei of real origin for the sensory part of all the spinal nerves, and for the central as well as for the peripheral parts. The researches of the last five years have shown that the fibres of the posterior roots of the spinal nerves, on arriving in the medulla, bifurcate there, and that the two branches of the bifurcation end in the grey matter by terminal ramifications. These fibres do not begin, but end in the medulla.

With regard to some of the ganglia situated on the course of the cerebral nerves, it is clear that the ganglia of the fifth, of the glosso-pharyngeal and of the vagus are in all points comparable to the spinal ganglia; the spiral ganglion of the auditory nerve is also comparable to a spinal ganglion, but the nerve-cells retain the bipolar form.

Degeneration and Regeneration of Injured Peripheral Nerves.*—A. Freiherr von Notthafft has made one hundred experiments on dogs, guinea-pigs, and rabbits, in order to study the processes of degeneration and regeneration in injured peripheral nerves. After any injury (burning, crushing, or incision) which totally destroys the nerve-substance at any one spot, there is a degeneration of the whole peripheral portion and of a smaller central portion about 1·5 cm. in length. Beside the injured region there is a destruction of medullary and axial fibres as the direct result of the wound. The "paralytic" degeneration which follows after forty-eight hours is due to several causes: the loss of fluid narrows the axial fibres, their shrivelling separates the medulla into pieces, the contraction of the pieces produces a transverse division of the axial cylinder, and so on. A division of nuclei and an increase of the protoplasm in Schwann's sheath perhaps help in the progressive disruption. The degenerating medulla exudes into the lumen of the sheath a fluid which is gradually absorbed. The medullary sheath does not undergo fatty degeneration, though infiltration of fat may occur, nor does it undergo chemical modification after the manner supposed by Neumann and Eichhorst, nor do leucocytes help, nor is the proliferation of nuclei the sole cause of degeneration, as Ranvier maintains. The degeneration spreads very rapidly from centre to periphery. It is likely that the proliferating nuclei of Schwann's sheath help both in degeneration and regeneration. With the origin of new axial filaments they have nothing to do. The new nerve-fibres always grow from the old central stumps, and the growth is continuous from centre to periphery. They appear about the eighth or ninth day, and begin to get a medullary sheath about the tenth or eleventh day. It seems likely that the new Schwann's sheath is formed from the cells of the old one. The regeneration of severed nerves is most likely if the ends be tied, or, when that is impossible, if another piece be interpolated by means of silk thread between the two ends.

Free Intra-epidermic Nerve-endings.†—Prof. A. Van Gehuchten, applying the method of Golgi to the skin of rats and mice, finds that

* Zeitschr. f. Wiss. Zool., lv. (1892) pp. 134–88 (1 pl., 2 figs.).
† Verhandl. Anat. Gesell., 1892, pp. 66–9.

the subcutaneous nerve-plexus is a true plexus, and not a network; the nerve-fibres which form it never anastomose with one another, though they interlace in a very complicated way. The number of fine nerve-fibrils which penetrate vertically into the epidermis is truly incalculable; in good preparations a very forest of fine nervous branchlets may be seen penetrating the epidermis and conveying sensibility to all points of the skin.

Golgi's Method and the Distribution of Nerve-fibres.*—At the annual meeting of the German Anatomical Society, in June 1892, a discussion followed a paper by Dr. Retzius on the peripheral mode of termination of auditory nerves. Prof. Waldeyer thought it a matter for consideration whether Golgi's method really showed the final terminations of the nerves; Prof. Claus thought that there was no doubt that in Invertebrates there was passage between nerve-fibres and peripheral sensory cells; Prof. Kölliker thought it possible that in lower animals nerve-fibres arose from epithelial cells, though it was not the case in higher forms. Prof. Merkel related the experience of a worker in his laboratory who used the methylen-blue method. Dr. Retzius remarked that the images of epithelial and sensory organs obtained by Golgi's method were quite sharp and certain. Herr Zimmermann gave an account of the connection between sensory cells and nerves as shown by Ramon's method.

γ. General.

Survey of Fishing Grounds, West Coast of Ireland.†—Mr. E. W. L. Holt, in a report to which Prof. A. C. Haddon prefixes an introductory note,‡ gives a very valuable account of the marine fauna of the West Coast of Ireland. Echinoderms appear to be the chief food of the Piper, Haddock, and Common Dab, while they are largely eaten by others, and occasionally by Cods and Skate. Annelids are the chief food of the Lemon Dab, Pole Dab, and Common Sole; Gephyreans are occasionally eaten by the Plaice and Common Sole; Nemerteans are rarely eaten by the Cod. Of this last, as of some others, the chief food is Crustaceans. Lamellibranchs form the chief food of the Plaice, and are largely eaten by the Spotted Ray. Gastropods and Cephalopods are less frequently eaten. Some fish live chiefly or almost altogether on other fish; Sand-eels appear to be the most universally persecuted, and it is noted that the Dragonet and Weever are not infrequent victims, in spite of their formidable armature.

Plankton of Plymouth.§—Mr. E. J. Bles was engaged during the past summer in investigating the surface-fauna of the Plymouth waters. It appears, during that period, to have been exceptionally small, and it is possible that one may associate with this fact three others—the Plymouth mackerel fishery was a failure, dog-fishes were not obtainable during June and July, and *Aurelia aurita*, which in summer is usually common, was extremely scarce in the Sound and tidal waters of Plymouth.

* Verhandl. Anat. Gesell., 1892, pp. 79–81.
† Scientific Proc. R. Dublin Soc., vii. (1892) pp. 225–477.
‡ Tom. cit., pp. 221–4. § Journ. Marine Biol. Assoc., ii. (1892) pp. 340–3.

The Hydroid medusa *Obelia lucifera* was very plentiful throughout June; on adding a saturated solution of corrosive sublimate to the sea-water containing them the animals were stimulated to phosphorescence, and the position of each medusa was indicated by a small clear ring of blue light round the margin of the umbrella. There was an abundance, on July 4th, of the young of the Tunicate *Oikopleura lophocerca*. On the same day there was a great increase in the number of Dinoflagellates, and oceanic Radiolaria of Haeckel's group Acantharia were also found. It seems that the surface-layers of the sea are, with their plankton, displaced through considerable distances by the prolonged or powerful action of the wind in one direction. The interesting Archiannelid *Protodrilus leuckarti*, not hitherto recorded from any locality other than the Mediterranean and the Black Sea, has been found.

Marine Invertebrate Fauna of Plymouth.*—Mr. W. Garstang has some notes on the collecting operations undertaken by the Marine Biological Laboratory in 1892. The rare *Leucosolenia lacunosa* was dredged in 25 fms.; this calcareous sponge was attached by its slender stalk to an old egg-case of *Scyllium canicula*, which was itself adhering to the stem of a Gorgonid. *Tubiclava cornucopiæ*, first dredged in the Shetlands, is represented by a colony of 90 to 100 polypes. *Haliclystus octoradiatus* has been discovered in hundreds. Of the Anthozoa the *Eloactis Mazeli* of Jourdain is an interesting addition to the British fauna, and, on the whole, the Actinians of Plymouth offer a valuable field for special investigation. The researches of Mr. Gamble show that there exists a Rhabdocœle fauna unparalleled in the number of its species. Of Annelids the dredge is constantly bringing up species whose presence has been hitherto unsuspected; *Myxicola* has been added to the list of Plymouth Annelids, and *Staurocephalus rubrovittatus* has been found on several occasions. *Phoronis* is quite plentiful in certain parts of the Sound, and its beautiful larva has been a feature of the autumn tow-nettings. *Crisia denticulata*, a Polyzoon which Mr. Harmer reported to be rare at Plymouth, has been found abundantly in the deeper waters a few miles outside the breakwater.

The principal additions to the Gastropod fauna have been from among the Opisthobranchia. *Amphorina cærulea*, a species which has not been met with on English coasts since the time of Montagu, was dredged on September the 12th. Perhaps the most interesting addition of all has been the rediscovery of D'Orbigny's *Stiliger bellula*. A species of Amphipod which appears to be very locally distributed, *Unciola crenatipalma*, is found plentifully on a muddy bottom at a depth of twenty fathoms. The male of *Anthura gracilis* has been found and confirms the prediction of Norman and Stebbing concerning the secondary sexual characters of the male of this species. Of the Schizopod Crustaceans, *Macromysis flexuosa* has been very abundant during the past summer, countless myriads being found close to the water's edge in the estuary of the Yealm. *Gastrosaccus normani*, which does not appear to have been seen on our coasts since 1871, was taken in the surface net on the night of September the 21st. Among the Decapoda *Achæus Cranchi* is a valuable addition.

* Journ. Marine Biol. Assoc., ii. (1892) pp. 333–9.

Excretory System of Animals.*—Prof. L. C. Cosmovici presented to the second International Congress of Zoology a report on "What is meant by 'aquiferous system, segmental organs, excretory organs, nephridia.'" The following are his conclusions :—

In every animal organism there is performed the important physiological process of excretion, which is in most cases effected by glands which are more or less simple, more or less metameric, and either reduced to a pair of more or less twisted tubes, or consisting of paired renal or nephridial glands. We must expel from our scientific nomenclature the terms segmental and excretory, for in the first Williams comprehended the gonads and their efferent ducts, and by excretion most anatomists understand the evacuation of any product whatever. In most aquatic animals there is a more or less well organized aquiferous system, which is either connected with the circulatory apparatus, when it allows of the introduction into the interior of certain quantities of water necessary for the erection of locomotor organs (Echinoderms); or it is more or less in relation with the digestive apparatus (many Protozoa, Sponges, Rotifers). In animals which have no nephridia the products of disassimilation probably fall into the aquiferous system and are thus evacuated; this fact does not authorize us in considering this system as homologous with that of the nephridia. We must not confuse the efferent ducts of the generative products with the segmental organs, as is so often done in Chætopoda, for the latter appear first and often aid the gonads by allowing them to graft on to them their oviduct or sperm-ducts. The more or less vesicular tubes of the nephridia always terminate by more or less ampullæform extremities which are ciliated internally, and they never end by orifices, unless the generative ducts are connected with them.

Studies in Developmental Mechanics.†—Dr. Hs. Driesch has published further investigations and reflections on this subject. Increase of temperature separates the two first segmentation cells in *Sphærechinus*, and there result two blastulæ loosely connected, or separate from one another. The removal of one cell from the 4-cell stage of *Echinus* does not hinder the formation of a normal larva. Indeed, a single quarter can develope normally. Warmth may slightly alter the character of the segmentation, and yet a normal organism may result. The egg-membrane is unessential in segmentation. Segmenting ova abnormally altered by pressure may still form typical Plutei. Stages deformed to such an extent that they are two-layered plates with eight cells in each layer may still turn out normal Plutei—a fact against His's theory of the specific importance of individual blastomeres. What should form one pole forms the two sides, and what should form the other pole forms both,—which is certainly a notable change. Without inhibiting development, portions may be removed from the segmenting ovum, but the portion left must not be less than about a quarter. All these facts point to the conclusion that the blastomeres of Echinidæ must be very homogeneous. Ova which divide simultaneously into four are regarded by Fol and by the brothers Hertwig as doubly fertilized. Assuming this, Driesch notes that the whole rhythm of division is in these cases

* Congrès Internat. de Zoologie, II. i. (1892) pp. 16-40.

† Zeitschr. f. Wiss. Zool., lv. (1892) pp. 1-62 (3 pls.). See this Journal, 1892, p. 13.

twofold; thus, the 16-cell stage is a double 8-cell stage, but the gastrula stage is never reached.

The rest of Driesch's memoir is occupied with a discussion of general morphological and ætiological questions on which his experiments shed light.

B. INVERTEBRATA.

Mollusca.

γ. Gastropoda.

Repair of Shell of Helix aspersa.*—Prof. R. Moynier de Villepoix cut away from a young hibernating *Helix aspersa* several millimetres of the peristome and test, and left it under a bell-jar without food. On about the third day the denuded part of the mantle was seen to be covered with a greyish layer of calcareous matter, and the peristome was completely reformed. We see, then, that *Helix* is not only capable of repairing breaches in its shell, but it can, at any rate when it is young, completely reform the extreme edge, which then continues to grow normally.

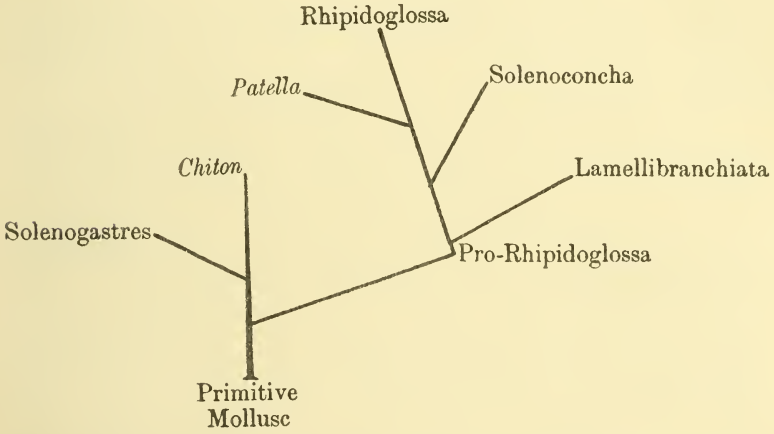
Growth and Structure of Shell in Velates conoideus and other Neritidæ.†—Mr. B. B. Woodward describes the remarkable mode of shell growth in *Velates conoideus* (= *Neritina schmideliana*, = *Nerita perversa*), and compares it with other Neritidæ. He first discusses a series of *Neritina* species which exhibit stages in the degree of removal of the columella and inner walls of the whorls, and in the development of the septum. The genus *Velates* is represented by two species—*V. conoideus* Lamk. and *V. equinus* Bez.—which occur together in the lower and middle Eocene of the Paris basin. In *V. equinus* the shell growth is normal. So far as the myophore is concerned the shell of *Velates conoideus* offers in the growth of the individual a series of conditions which in the recent forms find their parallel in distinct species; in its earlier stages the paries and the incipient septum go to form the myophore; in the later period the septum alone plays that part, as in *Nerita crepidularia*. "Put in homely phraseology, the mode of enlarging the shell in *Velates* reminds one of nothing so much as of the Irishman who raised his roof by digging out the floor of his cabin." The very hard periostracal layer consists in the main of calcium carbonate with a siliceous residue. The crystalline layer is peculiar in the arrangement of its plates; the presence of aragonite in addition to calcite is highly probable.

Slugs of Ireland.‡—Dr. R. F. Scharff has undertaken the examination of the Slugs of Ireland chiefly with a view of solving some of the difficulties regarding the distribution of terrestrial animals. Notwithstanding that the sea is deadly both to Slugs and their eggs, he finds that those of Ireland are closely related to, and are in most cases identical with those of the Continent of Europe. Of the thirteen species found in Ireland, twelve are identical with those of Great Britain. Under each species the author treats of the external characters, the

* Bull. Soc. Zool. France, xvii. (1892) pp. 30–1.
† Proc. Zool. Soc., 1892, pp. 528–40 (2 pls.).
‡ Sci. Trans. R. Dublin Soc., iv. (1891) pp. 513–58 (2 pls.).

anatomy, reproduction, habitat, food, and general distribution, but the anatomical remarks have been cut rather short.

Structure and Relationships of the Solenoconcha.*—Dr. L. H. Plate begins by describing the structure of *Dentalium* (*D. dentale*, *D. vulgare*, *D. rufescens*) and of Siphonopoda (*Siphodentalium vitreum*, *Siphoentalis affinis*, *Cadulus subfusiformis*), and then discusses their systematic position. Gastropods they resemble in the radula, the jaw-plate, the unpaired shell, the retractor muscles, the unpaired gonads, and the buccal nervous system. Among Gastropods the Rhipidoglossa resemble Solenoconcha in bilateral symmetry, distinct head, œsophageal pouches, separate sexes, and perhaps even in the disposition of the mantle. The Solenoconcha resemble Chitonidæ in their symmetry, in the sub-radular organ, and in the œsophageal glands. Still more does the *Patella* type resemble that of *Dentalium*. With Lamellibranchs



also, as Lacaze-Duthiers has urged, the Solenoconcha present affinities, e.g. symmetry, nervous system, nephridia, &c. But the conclusion to which Plate comes is this, that the Pro-Rhipidoglossa, ancestors of the Rhipidoglossa, are the roots whence the Solenoconcha and the Lamellibranchs have sprung. With Grobben's idea that the Solonoconcha are related to Cephalopods the author entirely disagrees. His views are expressed in the accompanying diagram.

Molluscoida.

a. Tunicata.

Budding of Botryllus.†—Mr. A. Oka has made a study of the process of budding in *Botryllus*. His results point clearly to the mesodermic nature of the peribranchial sac, which arises from the gut like the cœlom pouches in *Amphioxus*. He believes that the peribranchial space is a secondary cœlom. The vascular cavity is continuous with

* Zool. Jahrb., v. (1892) pp. 301–86 (4 pls.). See this Journal, 1892, p. 465.
† Zeitschr. f. Wiss. Zool., liv. (1892) pp. 521–47 (3 pls.).

the segmentation cavity and represents the primary cœlom; the pericardial cavity arises independently of the peribranchial cavity, but is probably analogous with it.

The bud developes from two layers, ectodermic and endomesodermic. The mesoderm is separated by the formation of the lateral diverticula. From the ectoderm, the body-wall, the inhalent and the exhalent tubes, and the brain developc. From the endoderm, the gut, the branchial sac, the hypophysis, &c., developc. The mesoderm forms the peribranchial sac and the heart. In the wall of the peribranchial sac the reproductive cells occur, and give rise on the one hand to the ova, on the other hand to the endo-mesodermic portion of the bud. The thin ectodermic layer which shares in the bud secondarily acquires an embryonic character.

β. Bryozoa.

Structure of Rhabdopleura.*—Dr. G. Herbert Fowler has a preliminary note on his observations on *Rhabdopleura;* all the new anatomical features which he has been able to detect are in entire agreement with the structure of *Cephalodiscus,* and *Rhabdopleura* may be taken to form a third member of the order Hemichordata.

The epistome is found to correspond to the proboscis of *Balanoglossus* and *Cephalodiscus,* and, as in them, it contains a portion of the cœlom, completely shut off from the other portions. The collar region contains the central section of the cœlom, divided into right and left halves by median septa; each half communicates with the exterior by means of its own collar canals. On the posterior face of this cavity there is an ectodermal thickening, which corresponds in position with the nerve-plate of *Cephalodiscus* and the nerve-tube of *Balanoglossus.* There is a rod-like structure, apparently half cellular, half gelatinoid, which corresponds in origin, structure, and position with the notochord of *Cephalodiscus.* The most notable part of the intestine is a short semicircular diverticulum, which occurs also in the just-named form. The absence of a proboscis pore or pores, and the absence of gill-slits are two negative characters in which *Rhabdopleura* differs from the two known Hemichordata, but Dr. Fowler thinks the points of agreement are so striking that it is impossible to separate the three organisms.

Arthropoda.

Origin of Tracheæ of Arthropoda from Setiparous Sacs.†—Mr. H. M. Bernard attempts to solve the following problem:—"Certain Chætopod Annelids migrated on to the land at an early geological period, and are now represented by the Tracheata, so called because of their breathing organs which are chitin-lined invaginations of the outer cuticle—whence came their respiratory organs?"

He deduces the tracheæ from setiparous glands, and urges that this harmonizes many of the anomalies presented by the tracheal systems of the Arthropoda. The diffuse arrangement of the tracheæ of *Peripatus* is derived from the bristle-glands which were scattered over the surface of the body, while the regular metameric arrangement of the tracheæ

* Proc. Roy. Soc. Lond., lii. (1892) pp. 132–4 (3 figs.).
† Zool. Jahrb. (Anat. u. Ontog.), v. (1892) pp. 511–24 (3 figs.).

seen in the Hexapoda is explained by referring them back to the acicular glands of vanished dorsal parapodia. Specialization of parts of the body explains the incompleteness of the metameric arrangement in the adult Hexapod.

The only difficulty seen by the author is to be found in the arrangements exhibited by the Arachnida, for they possess coxal glands, with which apparently there is nothing to correspond in the Hexapoda. It is urged, however, that these glands may be left out of consideration without seriously affecting the derivation of tracheæ from setiparous glands; if, however, it can be shown that the coxal glands of the Arachnida are developments of Annelidan acicular or setiparous glands the arguments used in the present paper would be considerably strengthened.

a. Insecta.

Development of Melolontha vulgaris.*—M. V. Raspail has some notes on the development of *M. vulgaris*, which like many Coleoptera, has a very long larval life; it is remarkable, however, that the length of this larval life may be three years or four. This difference has been erroneously attributed to differences in temperature and food; the author finds that it is really due to differences in humidity, for a generation of four years has been found to correspond with a series of dry seasons, and the three-year form to two damp years.

Structure and Life-history of Encyrtus fusicollis.† — Prof E. Bugnion gives an account of this small hymenopterous parasite. The eggs are laid in the second half of May when the larvæ of *Hyponomeuta* (the host) are about a centimetre in length. By one puncture the female introduces a chain of 50–120 ova into the perivisceral cavity. Sometimes the same larva is punctured by two or three individuals. The membranous tube enclosing the embryos seems to be a cuticular formation of an internal epithelium which is derived from the fusion of the amniotic or serous envelopes of the embryos. The granular substance surrounding the embryos within the tube is probably vitelline, but it increases by osmosis from the lymph of the host. It nourishes the larvæ until the 20th to 25th June, when they moult, rupture the tube, and begin to feed directly upon the lymph of their host. As the time of metamorphosis approaches, the larvæ devour the viscera, and each becomes about the 7th July encapsuled in a chamber. The host dries up; the nymph period lasts about three weeks; the hatching occurs from 27th July to 2nd August. In one host the parasites are generally either male or female, the former probably the result of parthenogenetic development, the latter of early fertilization. Pairing occurs immediately after liberation and seems to last only for a few seconds.

* Bull. Soc. Zool. France, xvi. (1891) pp. 271–5.

† Rec. Zool. Suisse, v. (1890) pp. 435–70 (2 pls.), and 1892, pp. 471–534 (4 pls.). This final part of the 'Recueil Zoologique Suisse' (October 1892) contains the sad announcement, "Le 13 mars 1892, M. le Professeur Hermann Fol, directeur du Rec. Zool. Suisse, s'embarquait au Havre, à bord du yacht l'*Aster* armé en vue d'une campagne scientifique. . . . Plusieurs mois se sont écoulés depuis son départ et l'on est encore sans nouvelles du yacht et de ses passagers. Les recherches entreprises par le Ministère de l'Instruction publique et par la famille de M. Fol sont restées infructueuses."

International Relations of Lomechusa.*—Herr E. Wasmann continues his account of the way in which *Lomechusa strumosa* is received and treated by various ants. The beetle was transferred suddenly from a nest of *Formica rufa* to one of *F. pratensis* and was hospitably received. By *F. exsecta* the guest was received in friendly fashion, but with some curiosity; it was not fed nor much licked. In independent colonies of *F. fusca*, the intruder was at first assaulted, but was soon being licked and fed. A similar story is told of *F. rufibarbis* and *F. fusco-rufibarbis*. When *Lomechusa* was introduced into a mixed colony of *Polyergus rufescens* and its helper *F. fusca*, the latter tended to attack the visitor, but soon became hospitable, while the master ants paid no heed. The large species *Camponotus ligniperdus* was far from hospitable; the first *Lomechusa* introduced was speedily beheaded; a second was treated less impatiently but was eventually killed; and all subsequent attempts at introduction failed. To *Lasius fuliginosus* the visitor was not welcome, nor did it seem to feel at home among its far from fragrant hosts. So with *L. niger* and *L. umbratus* the reception was hostile or at best indifferent. An introduction also failed with *Myrmica scabrinodis*, *M. ruginodis*, *M. lævinodis*, *Tapinoma erraticum*, *Tetramorium cæspitum*, *Leptothorax tuberum*, *Formicoxenus nitidulus*.

The international relations are perfect between *Lomechusa* and all colonies of *F. sanguinea*, *F. rufa*, and *F. pratensis*. But as has been noticed above there are numerous cases in which a hostile reception soon gives place to hospitality. Herr Wasmann believes that the friendliness of *F. sanguinea* to *Lomechusa* is quite instinctive, but the recognition depends on the fact that the guest makes a pleasant appeal to the senses of its hosts. It is important to note its peculiar smell, its yellow secreting tuft, the aromatic secretion which the ants lick, and its initiative in approaching the ants and touching them with its antennæ. Herr Wasmann gives a careful analysis of the whole matter, and promises an account of *Atemeles* and its international relations.

Facts concerning Sex and Reproduction in Hymenoptera.†—Herr C. Verhoeff describes under the name "Proterothesia" the remarkable fact that in the nest of Fossoria, Vesparia, and their parasites, the tenants of the anterior cells are male, those in the posterior cells female. This is the case with *Crabro capitosus*, *C. sambucicola*, *Rhopalum clavipes*, *Trypoxylon figulus*, *Chevrieria unicolor*, *Prosopis brevicornis*, and *Osmia rubicola*. No exceptional case is known to the author, but the nests may be wholly male or wholly female. Of these he gives eleven different cases. "Proterocraty" is another fact—the individuals which appear first among the males or among the females are stronger than those which come after them. The "Proterandry" described by W. H. Müller prevents pairing between the sexes of one nest. Proterothesia and proterandry are correlated facts; in conjunction only are they of importance. It seems likely that the nutritive supply has much to do with the proterothesia and proterocraty. Another frequently observed fact is polyandry. There is not only a struggle between males, but the large number of males allows a selection of the fittest among the fit, and

* Biol. Centralbl., xii. (1892) pp. 638–69.
† Zool. Anzeig., xv. (1892) pp. 362–70.

the strongest are first in the field. The author's facts form an important contribution to the biology of sex and reproduction.

Use of Spines in Nymphs of Hymenoptera.*—Herr C. Verhoeff finds that the spines of Anthracine nymphs (Diptera) are used not only in boring but in locomotion, as in Cossidæ among Lepidoptera, but in the fossorial and other Hymenoptera the spines and tubercles are not locomotor but help in the last larval moulting. This, which is probably the primitive function, the author terms "helcodermatic."

Life-history of Phryganidæ.†—Gräfin Maria von Linden has some interesting notes on Phryganid larvæ, apparently Leptocerinæ. She describes the protective gelatinous envelope of the eggs, the manner in which the larvæ escape, the formation of the larval case, and so on.

Proboscis of Diptera pupipara.‡—Herr F. H. Müggenburg describes in great detail the proboscis of *Melophagus ovinus*, and also of *Lipoptena cervi*, *Hippobosca equina*, *Anapera pallida*, *Braula cæca*, and *Nycteribia Leachii*. His results go to show that Hippoboscidæ and Braulidæ are nearly allied to Muscidæ. This conclusion is based on anatomical and embryological facts, but is corroborated by the occurrence of species of *Musca* with reproductive habits like the Pupipara, and by the apparently oviparous habit of *Braula cæca*.

δ. Arachnida.

Distribution of Spiders.§—Dr. Marx finds that the Arctic Spider-fauna is composed of the ten families whose species constitute the main bulk of the entire Spider-fauna of the world; they are cosmopolitans and are found almost everywhere where animal life is possible. The Arctic genera are, without exception, those which also occur in other regions of the world, and, as yet, no one genus has been found to be original to that zone of eternal ice and snow. This is a very remarkable fact, since in all other groups of Arthropods the polar fauna is distinguished by special and peculiar forms. Very many species occur which live in milder climates and under entirely different conditions and influences. The differences between the faunæ of the eastern and western hemispheres are slight.

Malayan and Papuan Spiders.‖—Sig. T. Thorell describes (in Latin) 462 Indo-Malayan spiders, including 33 new genera—*Euetria*, *Cnodalia*, *Milonia*, *Callinethis*, *Orsinome*, *Limoxera*, *Mitoscelis*, *Stethopoma*, *Perania*, *Badumna*, *Astratea*, *Urgulania*, *Libania*, *Dolothymus*, *Musæus*, *Narcæus*, *Hedana*, *Peltorhynchus*, *Microcyllus*, *Zametopias*, *Nydia*, *Lycosella*, *Passiena*, *Rhomochirus*, *Tapinattus*, *Epocilla*, *Chrysilla*, *Gelotia*, *Oreevia*, *Bathippus*, *Carrhotus*, *Bindax*, *Nicylla*.

Two new Hydrachnids from the Rhætikon.¶—Herr F. Koenike describes *Zschokkea* g. n., most nearly related to *Hydrophantes* and

* Zool. Anzeig., xv. (1892) pp. 355–60 (5 figs.)
† Biol. Centralbl., xii. (1892) pp. 523–7.
‡ Arch. Naturgeschichte, lviii. (1892) pp. 287–332 (2 pls.).
§ Proc. Ent. Soc. Wash., ii. pp. 186–200. See Amer. Natural., xxvi. (1892) pp. 968 and 9.
‖ Ann. Mus. Civ. Stor. Nat. Genova, xi. (1891–2) pp. 1–491.
¶ Zool. Anzeig, xv. (1892) pp. 320–6 (4 figs.).

Bradypates, with *Z. oblonga* as the species; and *Feltria* g. n., with *F. minuta* as the species.

Hydrachnidæ.*—Herr F. Kœnike has some criticisms to make on Piersig's recent papers on Hydrachnids. These criticisms refer to the specific characters of *Arrenurus bisulcicodulus* Piersig, to Piersig's account of the nymph stages of *Brachypoda* (*Axona*) *versicolor*, and other forms, and to various questions of purely systematic interest.

Freshwater Mites.†—Herr R. Piersig describes the larvæ of *Midea orbiculata* Bruz, *Mideopsis depressa* Neum., and has notes on *Axona versicolor*, *Pachygaster tau insignatus*, *Marica musculus*, *Hydrodroma*, and others.

South American Pantopoda.‡—Dr. W. Schimkewitsch has described the Pantopoda collected on the 'Vettor Pisani' expedition. They include the following new species:—*Tanystylum Dohrnii*, *T. calicirostre*, *T. Chierchiæ*, *Ammothea Wilsoni*, besides *Pallenopsis fluminensis* Kr., *Phoxichilidium longicolle* Ph., *Phoxichilus charybdæus* Dohrn, and *Nymphon gracile* Leach. A useful table of the species of *Tanystylum* is given.

ε. Crustacea.

Habits of Gelasimus annulipes.§—Dr. A. Alcock finds that the enormously developed chela of the male of this common Indian crab is two and a half times the greatest length, and one and a half times the greatest breadth of the whole body; it is forty per cent. of the entire weight of the animal, and is of a beautiful cherry-red colour which fades to rose-pink. Whether this chela serves as a stopper to the mouth of the burrow or as a nuptial support, it is certainly, in this species, used as a club in the contests of the rival males and is a signal to charm and allure the females. If a female (the number of females in the cold weather is much less than that of the males) approaches the burrow of a male, the latter displays the greatest excitement, raising itself on its hindmost legs, dancing and stamping, and frantically waving its beautifully coloured big claw. When used as a club, these little crabs make savage backhanded sweeps at each other with their chelæ, which appear to serve also as a shears.

Germinal Area and Dorsal Organ of Gammarus pulex.‖—Prof. R. S. Bergh points out that in very young stages the germinal streak of *Gammarus pulex* lies transversely across one half of the egg, and that it gradually twists round, through a right angle, until its longitudinal axis is in a line with that of the ovum. The dorsal organ, regarded as originally asymmetrical in position, is not really so. From the first it lies on the middle of the back. The germinal streak changes its position; the dorsal organ does not.

* Zool. Anzeig., xv. (1892) pp. 263–8 (2 figs.).
† Tom. cit., pp. 338–43 (7 figs.).
‡ Atti (Mem.) R. Accad. Lincei Roma, vi. (1890) pp. 329–47 (1 pl.).
§ Administr. Rep. Marine Survey of India, 1891–2. See Ann. and Mag., x. (1892) pp. 415–6.
‖ Zool. Anzeig., xv. (1892) pp. 268–71.

Mid-gut of Artemia.*—Prof. J. Frenzel describes the lining epithelium and the process of secretion in *Artemia salina*, and in an Argentine species. Special attention is directed to the hair-fringe of the cells. This the author supposes to have a protective function, and suggests that it may be saturated with an anti-enzyme. The cells show a longitudinal striation which the author interprets as significant of a mechanical supporting framework. Towards the hind region of the gut the lining cells show minute crystalline needles of a red colour. Frenzel believes in two kinds of secretory epithelium, that in which the cells persist as permanent glands, and that in which they perish in secreting and are regenerated. In *Artemia* a vesicle forms in the secretory cell, the cell increases in size, the hair-fringe is lost, the nucleus disappears, and the cell bursts. Sometimes, however, in the anterior part of the mid-gut, cells are set free without any vesicle-formation; they burst into fine granules. As to absorption, it is maintained that this may occur in *Artemia* and in other Arthropods, &c., at any part of the food-canal, but there is at the same time division of labour, for the fore-part of the mid-gut is more secretory, the hind-part more absorptive.

The author adds a note on the mid-gut cells of caterpillars during pupation. The cylinder-cells have more or less red contents (in *Sphinx*, *Helias*, *Œceticus*, &c.). Before and during pupation these red cells are extruded, as if secretion continued although the gut is empty.

Early Development of Cirripedia.†—Mr. T. T. Groom publishes an abstract of observations made at Naples and Plymouth. The size of the ovum has much more relation to that of the nauplius than to that of the adult. Fertilization takes place in the mantle-cavity before the circumvitelline membrane is formed. After fertilization the egg diminishes in size, and commences to undergo rhythmical contractions, which do not cease till the protoplasmic and yolk-portions are completely separated; the former generally collects at the anterior or larger pole, and the latter at the posterior or smaller. When the nucleus divides one daughter-nucleus remains in the protoplasm, and the other passes into the yolk, the elements of which it has the power of transforming into protoplasm. The yolk becomes gradually covered by the successive emergence of fresh cells, and this process is accompanied by the division of the cells cut off from it. The yolk, indeed, may be regarded as having the value of a single cell (macromere), which gives off a succession of blastomeres (micromeres). The point where the blastoderm last covers the yolk nearly always represents the blastopore, and the nucleus which gives rise to both endoderm and mesoderm arises at or close to the same spot. After separation of the epiblast the yolk-cell or macromere still remains as a cell with a single nucleus; it represents both mesoblast and hypoblast; it immediately divides into two cells, each of which contains mesoblastic and hypoblastic elements. The mesoblast is formed by the cutting off in succession of segments from each of the two meso-hypoblast cells, and these form a plug of rapidly dividing cells just in front of the closed blastopore. When all the mesoblastic cells are cut off the two yolk-cells remain as the first two hypoblast cells. These last become divided into smaller cells equiva-

* Zool. Jahrb., v. (1892) pp. 248–70 (1 pl.).
† Proc. Roy. Soc. Lond., lii. (1892) pp. 158–62.

lent to the secondary yolk-pyramids of Decapods. Each yolk-pyramid is, later on, converted into an endoderm cell by radial contraction in a centrifugal direction; the archenteric cavity arises by the separation thus caused of the central portions of the pyramids from one another.

The appendages are marked out first by two transverse furrows which do not extend on to the ventral surface; the antennules, antennæ, and mandibles are probably serially homologous, and all may represent primitively postoral appendages. The body-cavity of the nauplius arises as a mixed blastocœle and schizocœle, and soon forms a cavity continuous from end to end of the body. The nervous system shows from the first a complex structure, especially in the Balanids, where it is most specialized in the Balaninæ. It seems from the first to include the ganglia supplying the antennules, as well as the representative of the archi-cerebrum. The antennæ and mandibles are respectively in close relation with the circum-œsophageal connections and subœsophageal ganglion. There is a most remarkable agreement between the nauplii of the different species in the general structure of the carapace, labrum, &c., and as this extends to the minutest detail in the case of the appendages it is clear that the features in question have been inherited from some stage of the common ancestor. On the other hand there are nearly always such differences in the new-laid ova as to allow of the separation of genera or even of species.

The agreement in the development of *Balanus* and *Lepas*, stage by stage, shows that the ancestor of the Thoracica underwent a metamorphosis similar to that of the present members of the group, and that, therefore, the Nauplius- and Cypris-stages were not evolved within it. Where variations occur, the variable features are the same in all the species; the most conspicuous of them are those which affect the processes of cell-division. The size, shape, and colour of the ova and embryos of a species vary not inconsiderably, and though the nauplii differ somewhat in size and shape no conspicuous variations occur in structure.

Vermes.

a. Annelida.

Anomalies of Segmentation in Annelids.*—Dr. C. J. Cori describes an abnormality in *Lumbricus terrestris*, one of the median segments being divided into two on the right side. He found similar intercalated segments in *Hermodice carunculata*, *Lumbriconereis*, *Halla parthenopeia*, and *Diopatra neapolitana*, and is inclined to refer the abnormality to very favourable developmental conditions which resulted in unusually rapid growth and consequent "slips" in segmentation. Possibly these cases may be of interest in connection with the theory of metamerism, for instance, in bridging the gulf between the irregular segmentation occurring in Nemerteans and the regular segmentation of Annelids.

Earthworms from the Malay Archipelago.†—Dr. R. Horst gives an account of the earthworms collected during his travels in the Malay Archipelago, by Prof. Weber. In all twenty-one species were collected,

* Zeitschr. f. Wiss. Zool., liv. (1892) pp. 569–78 (1 pl.)

† Zoolog. Ergebn. einer Reise in Niederländisch Ost-Indien, ed. by M. Weber, ii. (1892) pp. 28–77 (3 pls.).

eight of which are new; it has been found necessary to establish two new genera which are called *Glyphidrilus* (*G. weberi* sp. n.) and *Amodrilus* (*A. quadrangulus* sp. n.), both of which belong to the Geoscolecidæ. Species of Acanthodrilidæ, all belonging to the genus *Benhamia*, are now for the first time described from the Indo-Malayan region. The presence of *Desmogaster* in Sumatra is a new point of agreement between the earthworm-fauna of the Indian continent and that of the Malay Archipelago.

A number of anatomical details are given, and there are critical notes on the work of cotemporaneous observers; with regard to the theory that the caudal zone of *Protoscolex* is a zone of growth, Dr. Horst thinks that there is not sufficient ground for accepting it. The largest specimen of *Perichæta musica* collected measured 440 mm. in length. Six species of *Perionyx* are enumerated and a key is given by which they may be distinguished.

British Tree- and Earth-Worms.*—The Rev. H. Friend remarks that no attention has been given in this country to the study of tree-worms, whose chief service consists in reducing useless timber to vegetable mould. Thanks, however, to the works of Eisen, Rosa, and Levinsen, he has been able to determine all the tree-worms which have as yet been detected in this country. He has found *Allolobophora* (*Dendrobæna*) *celtica* Rosa, *A.* (*D.*) *Boeckii* Eisen, *A.* (*D.*) *subrubicunda* E.; this last is known to anglers as the Cockspur or Gilt-tail; *A.* (*D.*) *constricta* R., *A.* (*D.*) *arborea* E., and *A.* (*D.*) *Eiseni* Levinsen. A tabular view is given of these six species. The author next describes a new British species of *Lumbricus*, which he calls *L. rubescens*,† which has been found in Yorkshire, Middlesex, Sussex, and elsewhere. A revision follows of the genus *Lumbricus*, of which four species are recognized,—*L. terrestris* L., *L. rubescens* F., *L. rubellus* Hoffm., and *L. purpureus* Eisen; a revised synonymy and a tabular view of the species is given.

New English Genus of Aquatic Oligochæta.‡—Dr. W. B. Benham has discovered at Goring-on-Thames a new form of aquatic Oligochæte, which he calls *Sparganophilus* (*S. tamesis*) and which belongs to his family Rhinodrilidæ. All the specimens were found among the roots and the lower parts of the leaves of the bur-reed (*Sparganium ramosum*); it seems probable that, like *Criodrilus*, the new worm spends the greater part of the year at the bottom and only comes to the banks during August and September for the purposes of reproduction. *S. tamesis* is a delicate, pinkish worm, three to four inches long; the surface of the body exhibits a lovely violet to peacock-blue iridescence; at the anterior end the pink tint deepens, owing to the large hearts which are found there. The worm is very strong and active, and feels wiry and firm, almost like a Nematode.

The author gives a detailed account of the anatomy, and points out that *Sparganophilus* is a Rhinodrilid which, having become aquatic in habit, has undergone certain modifications, which give it at first sight a resemblance to *Criodrilus*, an aquatic Lumbricid. It has lost its gizzard;

* Journ. Linn. Soc. Lond., xxiv. (1892) pp. 292-315 (1 pl.). See also Nature, xlvi. (1892) pp. 621–3, where no complete reference to the J. Linn. Soc. is given.

† Mr. C. H. Hurst, Nature, xlvii. p. 31, thinks this is *Lumbricus festivus* Savigny. ‡ Quart. Journ. Micr. Sci., xxxiv. (1892) pp. 155–79 (2 pls.).

the nephridia have disappeared from the anterior somites; the cœlomic epithelial cells surrounding the nephridia are vesicular in character; a vascular network on the gut has broken down to form a sinus; and there are no dorsal pores.

As the home of the Rhinodrilidæ is America, the occurrence in England of a member of the family is very striking, but the Thames is visited by all sorts of traffic, and the cocoons may have been brought over with timber, or among the roots of some water-plants, such as *Anacharis alsinastrum* which has increased in our rivers.

One point in which *Sparganophilus* is very remarkable is the superficial position of the sperm-duct, which becomes subepidermic; such a position for the duct is unknown in any Oligochæte. Dr. Benham suggests that this is an archaic feature, the primitive sperm-duct having opened externally in the segment following the funnel, and a groove having appeared to carry the spermatozoa further back; later on this groove sunk into the epidermis, became a canal, and so gave rise to the long duct so usual among earthworms.

Eyes of Hirudinea.*—Herr B. L. Maier describes the minute structure of the eyes in *Hirudo*, *Aulostomum*, *Nephelis*, *Clepsine*, and *Piscicola*. He is convinced that they are eyes. They consist essentially of a cellular pigment layer and a retina of large strongly refracting cells. Within the latter there is a capsule of modified plasma which is usually invaginated as a knob or ridge. This capsule is probably homologous with the rod-structures of the cells which are sensitive to light in other eyes. Each cell is connected with a fibre from the optic nerve. In *Nephelis*, *Clepsine*, and *Piscicola* the nerve enters the eye from in front; in *Hirudo* and *Aulostomum* the main branch enters the posterior wall and extends axially through the eye, while a second branch unites anteriorly and ventrally with the foremost cells.

Blood-pigment of Gephyrea.†—Dr. A. B. Griffiths has a note on the red pigment with respiratory properties which is found in the blood of *Sipunculus* and *Phascolosoma*, and was called hæmerythrin by Krukenberg. He finds that the empirical formula is $C_{427}H_{761}N_{135}FeS_2O_{153}$; the pigment exists in an oxidized and a reduced condition. This is the fourth respiratory pigment found in Invertebrates which contains iron.

β. Nemathelminthes.

Muscle and Nerve of Nematodes.‡—Dr. E. Rohde reports some observations on the histology of *Ascaris megalocephala* and *A. lumbricoides*. The cortical portion of the cœlomyarian muscle-cell is divisible into two different substances, the specially contractile muscular columns and the interfibrillar mass. The former are bands, generally of homogeneous appearance, which are set radially in the cortex of the cell, and alternate regularly with the interfibrillar mass. This latter is the continuation of the central medullary substance, and consists of a homogeneous hyaloplasm and a spongioplasm formed of a complicated plexus of fibrils and very greedy of colouring matters. The muscle cell of the

* Zool. Jahrb., v. (1892) pp. 552–80 (1 pl.).
† Comptes Rendus, cxv. (1892) pp. 669 and 70.
‡ SB. K. Akad. Berlin, 1892, pp. 515–26.

Hirudinea differs from that of Nematodes only in the fact that the contractile substance completely surrounds the medullary mass, so that the cell has not the form of a groove, but a closed tubule, which grows narrower at each end. Both kinds of cells show a great resemblance to the striated muscular fibres of Arthropods and Vertebrates in so far that in all the muscular columns are surrounded by the sarcoplasm; but there is this difference, that in Nematodes and Hirudinea the columns appear in the cortex, while in Arthropods and Vertebrates the whole thickness of the fibre is equally developed; to this last rule there are, however, exceptions. With regard to Chætopods, their muscular cells are formed on the same type as that of the Hirudinea, and the same is true of Molluscs. The nerve-fibres are, as a rule, tubes of the same thickness for their whole length, but they exhibit extraordinary variations in thickness; in all cases an axis-cylinder and a sheath can be distinguished; the former consists of a finely fibrillar spongioplasm with a homogeneous hyaloplasm imbedded in it. The ganglionic cells, which generally belong to the bipolar or multipolar type, have a coarse fibrillar spongioplasm. The nerves of Nematodes are essentially distinguished from those of the higher Worms by the absence of dotted substance.

The innervation of the muscle-cell is effected by its medullary substance, the presence of which forms an integral part of it. But the nerves and muscles are not only closely connected with one another, but also with the subcuticle. This layer has not a cellular structure, but forms a continuous protoplasmic mass in which nuclei appear to be regularly distributed. Fibrils are to be seen in the mass, where they form a close-meshed plexus or form parallel bands, circular, longitudinal, or radial in direction. In the Chætopoda and Hirudinea the fibrous tissue of the subcuticle and the spongioplasm of the nervous system are also closely connected; in them, as in Nematodes, the sheaths of the nerve-fibres are only a product of the close plexuses of the fibrous system of the subcuticle, with which they are often in close connection; in Nematodes, indeed, the passage of spongioplasm into axis-cylinder is so gradual, that it is not possible to make a separation between them.

Nerve, muscle, and subcuticle are found to be in unbroken connection by means of their spongioplasm, and the last is seen to play a part in innervation; its thick radial fibres, which stain very intensely, extend from the cuticle directly to the inner margin of the median line, where they unite into a very complicated network, and are thus brought into relation with the muscular processes.

With regard to the connection between sensory and motor nerve-endings, it is suggested that the stimulus exerted from without on the papilla is conveyed directly to the bursal ganglionic cell, whence it is conveyed by a second process to the bursal nerves; this, again, is a direct continuation of the motor ventral nerves; and it conveys the stimulus to the dorsal median nerve by means of numerous connecting fibres which lie in the subcuticle.

Muscle and Nerve in Mermis and Amphioxus.*—Dr. E. Rohde gives a short account of the relations of muscle and nerve in each of

* SB. K. Akad. Berlin, 1892, pp. 659-64.

these animals, and, on comparing them, sees a distinct resemblance between them. In both, the musculature consists of plate-like structures set in regular series; in one there is a central space filled by sarcoplasm, and of the value of a muscle-cell, and in the other it appears to be solid and surrounded by sarcoplasm. In both a number of the muscular columns that form the plates have the character of motor-fibres and pass transversely inwards to a sharply circumscribed cord, which extends to the nervous system. In both *Amphioxus* and *Mermis* the motor-fibres of either side do not arise simultaneously, but a certain distance behind one another to the right and left of the nervous system; in *Mermis*, however, there is not the same regular metamerism as in *Amphioxus*. In both the motor-fibres are accompanied by sarcoplasm which, in *Mermis*, distinctly forms the element that admits of innervation, while in *Amphioxus* it probably is, but cannot be with certainty asserted to be so.

Holomyaria.*—Dr. E. Rohde asks a question, which has been asked before, Are there any holomyarian Nematodes? Schneider, when forming the group, took *Gordius* as its chief representative, but Grenacher and Bütschli have contended that the musculature of that worm is formed of cells of the cœlomyarian type seen in *Ascaris*. Dr. Rohde does not deny that such cœlomyarian cells exist, but there are, he says, in *G. tolosanus* others of quite a different structure. They differ from the others in that they are completely open, not only on the inner, but also on the outer margin, and they are, consequently, formed essentially of two parallel plates, which are connected by the central medullary substance. Further, in the cœlomyarian cell the contractile margin extends as far as the inner boundary of the musculature, where there is but little medullary substance; in the others the plates extend hardly further than the middle of the muscular layer, but have on their inner side a well-developed medullary substance, in which numerous nuclei are contained.

These two kinds of cells are not only found together, but at their boundaries pass gradually into one another. Between the cells of both types there are often thin band-like masses of protoplasm, which have exactly the same appearance as the medullary substance of the cells. There can be no doubt that we have here to do with the first developmental stages of the muscle-cells, and it further seems clear to the author that the cells of the second type are cells in a young stage.

The histogenesis of the muscle-cell of *Gordius* would appear, therefore, to be this. The young cell consisting only of protoplasm, and probably connected with the subcuticle, as is the case in many cells of *Ascaris* (see above), commences its further development by becoming differentiated into muscular columns on the part which is turned towards the subcuticle. These columns become arranged in plates, gradually reach the inner boundary of the muscular layer, till at last the cell is cut off from the subcuticle, while at the same time the primitive protoplasm becomes almost completely used up. The development of the muscle-cell may go still further, for in some the contractile margin grows together on the inner side, and then, as in all Hirudinea, encloses the medullary substance.

Gordius preslii presents quite a different structure of the musculature

* SB. K. Akad. Berlin, 1892, pp. 665-7.

from that of *G. tolosanus;* it here consists of cells which are generally very flat, and widen out somewhat in their inner portion, where the medullary substance and nucleus can be distinctly recognized. They are chiefly remarkable for the fact that, while of the cœlomyarian type, they are open on the side opposite to that which is open in *Ascaris*, that is towards the subcuticle. As Grenacher and Schneider examined different species, it is not to be wondered at that they were led to discuss each other's results.

Male of Filaria medinensis.*—Dr. R. Havelock Charles reports that specimens taken from near the attached portion of the mesentery in the vicinity of the ileo-cæcal valve of human subjects are found to be double; the smaller specimen may be drawn out from a small opening near the middle of the body of the larger, and the author thinks that it is the long-sought-for male of the Guinea Worm. Dr. Charles thinks that the sexes are separate when set free in the stomach of the host, that the male is gradually used up in fertilizing the female, and by the time the latter reaches the surface of the body of the host its mate is dead.

Filaria Bancrofti and F. immitis.†—Prof. P. S. de Magalhães points out the differences between these two Nematodes. The most important specific difference lies in the form of the tail; this part is, in *F. immitis*, rolled up into several coils which are more numerous than in *F. Bancrofti;* the papillæ in the former are not broader at their base than at their tip as they are in the latter. In *F. Bancrofti* the two spicula are so set as to appear to be single.

Heterakis ‡—MM. A. Railliet and A. Lucet report the results of some observations on *Heterakis perspicillum* and *H. papillosa;* the former has been discovered in the small intestine of *Numida meleagris*, and the authors made some feeding experiments with it on a fowl, but the parasite failed to be developed. *Phasianus veneratus*, *Ceriornis satyra*, and *Anser domesticus* may be added to the list of already recorded hosts of *H. papillosa.*

Nematodes of Indian Horses and Sheep.§—Dr. G. M. J. Giles reports some observations on the life-history of *Sclerostomum tetracanthum*, as bearing on sclerostomiasis in equine animals; a new species‖ found in mules, and called *S. robustum*, is said to be a vicious bloodsucker. Dr. Giles ¶ has discovered in sheep in India the parasite *Œsophagostoma columbianum* recently described by Dr. Curtice in the United States, and he points out that he has brought together evidence to show that the damage to live stock wrought by parasites is much greater than has hitherto been suspected. Two new parasites** found in sheep are called *Strongylus colubriformis* and *Trichosomum verrucosum.*

* Scient. Mem. Medic. Officers Army of India, vii. (1892) pp. 51–6 (1 pl.).
† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 511–4 (4 figs.).
‡ Bull. Soc. Zool. France, xvii. (1892) pp. 117–20.
§ Scient. Mem. Medic. Officers Army of India, vii. (1892) pp. 1–24 (1 pl.).
‖ Tom. cit., pp. 25–30 (1 pl.).
¶ Tom. cit., pp. 31–44 (1 pl.).
** Tom. cit., pp. 45–9 (1 pl.).

γ. Platyhelminthes.

Geonemertes australiensis.*—Dr. A. Dendy gives an account of this, the fourth known species of Land Nemertine; its minute anatomy is found, on comparison with Bürger's researches on the marine Nemertea, to agree very closely with the marine forms, and especially with the Enopla. The circulatory system, however, appears to be merely a specialized portion of the excretory system. This last exhibits the most striking and important differences, for it consists of a system of intracellular tubules terminating in flame-cells. There is this objection to considering the network of tubules as excretory, that the author was unable to find any opening whatever to the exterior; it is possible, however, that it has been missed among the numerous genital apertures with which this animal is provided. The flame-like undulating structure connected with the tubules was, fortunately, seen in a crushed preparation of a living worm; its movements were extremely beautiful and characteristic, consisting of a series of undulations passing from base to apex in rapid succession, and causing the "flame" to exhibit alternate light and dark bands, and to give, at first, the impression of bubbles of gas escaping from the end of a tube under water. The flame appears to be made up of a bundle of long cilia, for faint indications of longitudinal striation were visible in it. With the possible exception of *Tetrastemma aquarum dulcium*, described by Silliman in 1885, this is the first time that flame-cells have been observed in Nemertines.

The present form differs from the three other known Land Nemertines in the presence of a large and indefinite number of eyes, the others having four or six. In *G. australiensis* there may be as many as thirty or forty, and there are indications that they may have arisen by the subdivision of four eyes; these eyes are sometimes dumb-bell-shaped, which is an indication that they multiply by division.

Bürger is in error in stating that all Land Nemertines are hermaphrodite, for this is not correct of either known species of *Tetrastemma* or of this new species. In it the females appear to be much commoner than males. The ova communicate with the exterior by narrow ducts which open along the sides of the body, and appear to allow of the entrance of spermatozoa, for which there are, in the male, numerous ducts. Both ovaries and testes are extremely numerous, and occur thickly scattered along the sides of the body.

G. australiensis is about 40 mm. long and 2·5 mm. broad when crawling. It is chiefly yellow in colour; the skin contains no rod-like bodies, but irregularly oval calcareous bodies lie in the deeper tissues.

Freshwater Nemertine in England.†—Dr. W. B. Benham has found in the river Cherwell, close to Oxford, a single specimen of a freshwater Nemertine, which may be *Tetrastemma aquarum dulcium*, but differs in some points from the description given by Silliman of that worm.

* Proc. Roy. Soc. Victoria, 1891 (1892) pp. 85-122 (4 pls.).
† Nature, xlvi. (1892) pp. 611 and 12.

Classification of Triclada.*—M. P. Hallez has a preliminary notice of his classification of Triclad Turbellaria. He divides the Turbellaria thus:—

Turbellaria	Diploblastica	Rhabdocœlida	*Graff.*
		Triclada	*Lang.*
	Triploblastica	Polyclada	*Lang.*

The order of the Triclads is divided into three tribes; Maricola, Paludicola, and Terricola. The order is defined in the following terms: Diploblastic Turbellaria, with an intestinal apparatus formed of three principal branches, of which the anterior is unpaired, and the two posterior paired and recurrent; pharynx situated at the point of junction of the three branches. Numerous follicular testicles, rarely reduced to one pair. Follicular vitelline glands, rarely (*Otoplana*) compact. Buccal orifice generally behind the middle of the body. Body more or less plano-convex. A genital cloaca and a uterus. Genital pores (both male and female) always behind the mouth.

The Maricola, or forms of marine habitat, have the intestinal branches lobed, or branching but little. Mouth in the second half of the body (except *Bdellura*). Body depressed. Uterus behind the genital orifice (except ? *Otoplana*). The families Otoplanida and Procerodida are free, but the Bdellurida are ectoparasitic.

The Paludicola live in fresh water, have the intestinal branches much ramified, the mouth in the second half of the body. Body depressed; uterus between pharynx and penis, with a dorsal uterine canal. In the Planarida and Anocelida the head is not formed for fixation, and the edges of the body are not undulated in a state of repose; the opposite obtains in the Dendrocelida.

The Terricola are terrestrial Triclads, with the branches of the intestine generally simply lobed. The mouth varies in position. Body variable in form. Uterus rudimentary. Ventral muscular system well developed. In the Limacopsidæ the dorsal surface is very convex, and the mouth is in the anterior third of the body. In the Geoplanida the body is subcylindrical, and the mouth almost median (except in *Microplana*), while in the family Polycladida the body is depressed and the mouth is in the posterior third of the body.

Land Planarians from Tasmania and South Australia.†—Dr. A. Dendy remarks that the only Tasmanian Land Planarian hitherto described is *Geoplana Tasmaniana*, which was collected by Darwin during the voyage of the 'Beagle.' The few specimens which the author and his wife were able to collect near Hobart go to show that the Land Planarians of Tasmania are very similar to those of Victoria. *G. alba*, *G. adæ*, and *G. walhallæ* have been collected, while there is a single specimen of a species allied to *G. quadrangulata* and *G. ventropunctata*. From Adelaide, Dr. Dendy has received *G. fletcheri*, a Victorian form, and a variety of it which he calls var. *adelaidensis*.

Land Planarians from Queensland.‡—Dr. A. Dendy describes the land Planarians collected by Prof. Spencer in his expedition to Southern

* Bull. Soc. Zool. France, xvii. (1892) pp. 106–9.
† Australasian Assoc. Advanc. Sci., 1892, Section D, 6 pp. (separate copy).
‡ Proc. Roy. Soc. Victoria, 1891 (1892) pp. 123–9 (1 pl.).

Queensland; they belong to six species—four of *Geoplana*, and one of *Bipalium* and one of *Rhynchodesmus;* only two are new to science, but of these *Geoplana regina* is a remarkably handsome worm. The widely spread *Bipalium Kewense* was, Prof. Spencer thinks, introduced by the agency of man to the locality (Gympie, Mary River) where he found it. Dr. Dendy thinks that the remarkable development of the head of *Bipalium* is a most marked and important character, and of great value for the purposes of classification; for it has a certain normal shape, to which it constantly returns.

Victorian Land Planarians.*—Dr. A. Dendy has a further descriptive paper on the land Planarians of Victoria, twenty-two species of which are now known; it is probable that they may be found at all times of the year by diligent searching, but they are more abundant in spring and autumn than in the drought of summer or the excessive moisture of winter. The present memoir contains systematic observations on twenty species of *Geoplana*.

Revision of Monostomida.†—Dr. G. Brandes does not agree with Dr. Monticelli in thinking that the Monostomida should be so defined as to include *Didymozoon;* speaking generally, the Monostomidæ are those digenetic Trematodes which have only one sucker, but it is to be understood that a truly Holostomid form like *Hemistomum cordatum* is to be regarded as a Monostomid. *M. liguloideum* is shown to be an *Amphiline;* *M. Squamula* is a *Distomum;* M. *echinostomum* is a synonym of *D. planicolle*, and *M. hystrix* of *D. endolobum*. *M. spirale* is also a Distomid, while *M. cochleariforme* appears to be a *Gastrostomum*, and it is not possible to be certain about *M. cornu*. *M. mutabile*, *M. flavum*, *M. arcuatum*, *M. Tringæ*, and *M. ellipticum* may be certainly regarded as good species, and the first four are allied to one another; similarly *M. verrucosum*, *M. alveatum*, *M. trigonocephalum*, and *M. Hippocrepis* seem to form a group of allies. About twenty-four good species of the genus appear to have been described.

Notes on Water-Vascular System of Mesostomidæ.‡—Dr. E. Sekera finds some exceptions to Graff's generalization that the oral and water-vascular orifices are always combined in this family. In *Mesostoma rostratum* the double excretory branches open by two excretory pores below the genital orifice; similar remarks may be made as to *M. cyathus*, *M. hirudo*, and *M. Hallezianum*. There are certain points of interest in *Castrada*, and in *Bothrioplana*, on which further information is promised.

Rare Parasites of Man.§—Prof. F. Zschokke has some notes on *Tænia* (*Hymenolepis*) *diminuta*, which has been five times recorded from the human intestine. An example of *Cysticercus cellulosæ* was found lying under the skin of a man thirty-nine years old. Another may be added to the three cases of the presence in Man of *Distomum lanceolatum;* twelve specimens were observed in a corpse in the Arabian Hospital at Alexandria.

* Trans. Roy. Soc. Vict., 1891 (1892) pp. 25-41 (1 pl.)
† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 504-11.
‡ Zool. Anzeig., xv. (1892) pp. 387 and 8.
§ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 497-500.

Tæniæ of Birds.*—Dr. O. v. Linstow has a few notes on *Tænia mallcus*, a Tænia without copulatory organs, and two new Cysticerci; the last belong respectively to the *Tænia setigera* of the Goose, and *T. brachycephala of Machetes pugnax;* the Cysticercus of the former lives in *Cyclops brevicaudatus*, and that of the latter in *C. crassicornis.*

Notes on Parasites.†—Prof. A. Railliet first calls attention to a specimen of *Cysticercus pisiformis* with six suckers, a rare occurrence, of which but few examples have been noted. This arrangement is coincident with a trihedral form of the chain of the adult *Tænia.* From the small intestine of a rabbit he has lately taken a tapeworm which was remarkable for the slate colour of the greater part of the body; though reduced by immersion in alcohol, the coloration was still very distinct; the worm appears to be an example of *Anoplocephala cuniculi.* The coloration is due to fine pigment granulations which are almost uniformly distributed in the parenchyma, and it is probable that it is due to the absorption and decomposition of hæmoglobin, for the rabbit was suffering from a number of small ulcers due to strongyles.

Four specimens of *Dipylidium caninum* showed not fenestrations, as in the cases recently described by Neumann, but one or two lateral hollows, the cause of which remains quite obscure. Three joints of this tapeworm have been observed by the author in the anal glands of the Dog.

Cysticercus tenuicollis has been found in a Kid from four to six weeks old; the case is of interest, not only from the youth of the host, but from the advanced stage of development reached by the parasite in the liver and lungs. The same species, which is known to infest various Ruminants, is now recorded from *Oryx beisa.*

In noting the occurrence of *Tænia tenuirostris*, which has been found in various wild Ducks and other birds, in the domestic Goose Prof. Railliet takes occasion to form two new genera; *Drepanidotænia* is for those of the type of *Tænia lanceolata*, of which the rostrum is armed with a simple crown of uniform hooks, of which one part is much longer than the other, while *Dicranotænia* is for those of the type of *T. coronula*, in which the uniform hooks, which are arranged in a simple crown, have the two halves equal or subequal.

Cysticercoid in Freshwater Calanid.‡—Dr. J. Richard detected in *Eurytemora lacinulata* a cysticercoid which appears to be identical with the one found by Mrázek in *Cyclops agilis;* this is the first time that a cysticercoid has been reported from a freshwater Calanid.

Structure of Solenophorus.§—Dr. C. Crety has given a detailed account of *Solenophorus megacephalus* Creplin, describing the two strata of the cuticle, the subcuticula, the parenchyma, the muscular system, the calcareous bodies, and the nervous system. Regarding an anterior commissure and two main lateral nerves as the primitive type of nervous system in Cestodes, the author contrasts the simple forms like *Amphiline* with more differentiated forms like *Solenophorus.*

* Centralbl. f. Bakteriol. u. Parasitenk., pp. 501–4 (1 fig.).
† Bull. Soc. Zool. France, xvii. (1892) pp. 110–7.
‡ Tom. cit., pp. 17 and 18.
§ Atti (Mem.) R. Accad. Lincei Roma, vi. (1890) pp. 384–413 (2 pls.).

δ. Incertæ Sedis.

Victorian Rotifers.*—Messrs. H. H. Anderson and J. Shephard enumerate six species of *Floscularia*, one of which, *F. evansoni*, appears to be new; it was found at Oakleigh, Victoria. Eleven known species of Melicertidæ are recorded, and *Melicerta ringens* is said to be common everywhere, and to be sometimes very large. New forms of this family are *Œcistes wilsoni*, *Lacinularia reticulata*, and species allied to if not the same as *Limnias granulosus*, and a new variety of *Œc. intermedius*. Four Philadinidæ have been found at the Botanical Gardens of Melbourne. *Asplanchna brightwelli* has for two years been found at the same spot at Brighton, Victoria, and *Asplanchnopus myrmeleo* has been found at all times of the year. Two Synchetidæ and two Triarthridæ are recorded. *Hydatina senta* was on one occasion found by hundreds. Four Notommatidæ, one Rattulid, one Dinocharid, two Salpinidæ, and one *Euchlanis* are enumerated. Of the three Cathypnidæ, *Cathypna* sp. (allied to *C. luna*) and *Distyla ichthyoura* are new. Of the Coluridæ *Metopidia ovalis* is new, as is *Pterodina trilobata* of the two Pterodinidæ. Of the three Brachionidæ named, *B. rubens* is common. In addition to the two determined Anureidæ there are probably some undescribed species. Messrs. Hudson and Gosse's book is evidently very useful to Australian workers at Rotifers.

Asplanchna.†—Prof. A. Wierzejski describes *Asplanchna Herrickii* de Guerne. It is most nearly related to *A. priodonta*, but has different "jaws," and a peculiar glandular organ composed of two large cells and opening above the cloaca. This gland Herrick erroneously regarded as testis; it is more like a cement-gland. The author also describes *A. Girodi*, and maintains that *A. helvetica* Imhof and Zacharias and *A. Krameri* de Guerne are, as v. Daday also believes, synonymous with *A. priodonta*. Two other Galician species are noted, *A. Ebbesbornii* Hudson and *A. Brightwellii* Gosse.

Echinoderma.

Echinologica.‡—Under this title Prof. S. Lovén gives us some of the results of his life-long researches on Echinoderms. Treating of the early stages of the body of regular Echinoids, he tells us that the form of the body is discoidal or lenticular, with five primitive locomotor suckers, solitary and provisional. The interior of the body communicates with the surrounding medium by a single large water-pore. The alimentary canal is closed at both ends and its possessor is endotrophic, taking in no food from without. In this way it represents a pupal or nymphal condition, intermediate between the pluteus and the adult. At this time there are being fashioned prehensile and masticatory organs, and a new endoskeleton is being built up within the envelope of the body; in this last there are two constituents—the calycinal system originating round the dorsal centre and formed of definite parts, and the coronal system; the latter arises from around the ventral centre, grows upwards, and is

* Proc. Roy. Soc. Victoria, iv. (1892) pp. 69–80 (2 pls.).

† Zool. Anzeig., xv. (1892) pp. 345–9.

‡ Bihang Svensk. Vet.-Akad. Hdlgr., xviii. IV. No. 1, 73 pp. (12 pls. and figs. in text).

itself a combination of two heterogeneous sets of plates—the ambulacral, which are binary from the beginning, and the secondary perisomatic interradia, which commence singly and then become binary.

The origin and history of the buccal membrane is thus described; the massive teeth and jaws "in the act of forming require an abundant supply of organized calcareous substance, and in the future imago they will demand, powerful instruments as they are of prehension and diminution, the greatest possible facility of motion. For their sake, it will seem to me, in order to prepare for them pliant surroundings, the currents of development are at last turned, and calcareous matter, just deposited in duly formed skeletal constituents, is reabsorbed, remodelling in the Cidaridæ and Echinothuriidæ, all but dissolving in the other groups."

The structure of the dental apparatus is considered in great detail, and it is suggested that further researches will tend to show that of the tooth-bearing Echinoids the Regularia are predacious, and perhaps mainly carnivorous animals, while the Irregularia are rather omnivorous.

We have been able to draw attention to some only of the points of interest in this memoir.

Catalogue of British Echinoderms.*—Prof. F. Jeffrey Bell has prepared a catalogue of the British Echinoderms in the collection of the British Museum (Natural History). The term British area is recognized as denoting an artificial region, and that accepted extends from the Faeroe Channel to the Channel Islands, while all forms are included which do not belong to essentially abyssal groups, such as Elasipods or Stalked Crinoids. One hundred and thirty-two species, some of which are very imperfectly known, are enumerated, compared with the fifty-five of Forbes's well-known works, but eight of these latter are not now regarded as good species.

After an introduction, in which there is given a sketch of Echinoderms and of their development, an account is given of the classification of the higher groups, in which the arrangement proposed by the author in 1891 is followed. The special part deals first with a description of the genera and species, to both of which "keys" are given by which a collected specimen may be quickly hunted down to his proper place; the diagnoses are drawn up as briefly as possible, and from what is said in the introduction it is clear that Prof. Bell has a holy horror of anything like verbosity or padding.

The last part of the work is occupied by an account of the distribution of the species, arranged in five tables. The first gives an account of the horizontal distribution of British Echinoderma beyond the "British Area," and in the same line the range in depth of each species is noted. Twenty-four species are not known beyond this artificial area, and these are (1) littoral and rare or very local, of which there are only three, (2) incompletely known—five, and (3) deep-water forms; many of the sixteen of these last are known from single specimens or have been only lately described. Only one species is not known beyond ten fathoms, whereas twenty-four have been dredged from more than

* 'Catalogue of the British Echinoderms in the British Museum (Natural History), by F. Jeffrey Bell, M.A. London, printed by order of the Trustees,' 1892, 8vo, xv. and 202 pp., 16 plates (2 colrd.) and 5 woodcuts.

750 fathoms. Three are not known above 1000 fathoms. Special attention is directed to the extension into deep water of what are commonly regarded as characteristically shore-forms, and it is pointed out that more discoveries of this kind are to be expected. The fifth table of distribution deals with divisions of the "British Area," of which there are nine taken—Faeroe Channel, W. Scotland, S. and W. Ireland, Irish Sea, St. George's Channel, English Channel, North Sea, Shetland and Channel Islands.

A word of praise is due to the plates, the first six of which will be more particularly interesting to the microscopist, as they are devoted to the spicules of Holothurians; no connected series of the spicules of British Holothurians have ever been before published, although it is now some years since the author called the attention of the Society to the necessity of this.*

In conclusion, we may congratulate the author on having, even so late in the day, discovered the proper form of the technical name of the group with which he has been concerned. He, here, very properly speaks of Echinoderma instead of Echinodermata, and if he should ever write a Catalogue of British Zoophytes and Anemones it is to be hoped he will call them Cœlentera and not Cœlenterata.

Echinoderms from West Coast of Ireland.†—Prof. F. Jeffrey Bell has a report on the Echinoderms collected off the West Coast of Ireland under the auspices of the Royal Dublin Society. The most interesting material was collected at 500 fathoms off county Mayo. Special attention is drawn to the great amount of variation exhibited by *Asthenosoma hystrix* and by a new species of *Astropecten—A. sphenoplax.* A recently described form, *Asterias murrayi*, only known hitherto from the West Coast of Scotland, was obtained. Sir Wyville Thomson distinguished two species of *Asthenosoma—A. hystrix* and *A. fenestratum*, but it is now shown that the amount of calcification of the plates of the test is a point in which individuals living together may differ among themselves. The differences in the size of the genital pores is, it is suggested, not a specific but a sexual character.

Larvæ of Echinoids.‡—M. H. S. Greenough has investigated larvæ by means of an apparatus which allows of rapid rotation around a horizontal axis under the Microscope; this permits of the determination of the form of a disturbed or isolated object and the relations of its different parts better than the ordinary method. In a living larva, about twenty-four hours old and stained with Bismarck-brown, a cap of the subspherical surface bounding the segmental cavity budded off mesoblastic cells; a large free mesoblastic cell was also observed. In a living larva, a day older, the hypoblast of which was already flattened but not yet invaginated, this layer was lined by two mesoblastic bands quite recognizable though little differentiated.

Larva of Asterias vulgaris.§—Mr. G. W. Field has been able to examine a large number of the larvæ of this star-fish, which are

* See this Journal, 1883, pp. 481-4.
† Sci. Proc. R. Dublin Soc., vii. (1892) pp. 520-9 (3 pls.).
‡ Bull. Soc. Zool. France, xvii. (1891) p. 239.
§ Quart. Journ. Micr. Sci., xxxiv. (1892) pp. 105-28 (3 pls.).

abundant at Wood's Holl in June, July, and August. The sperm mother-cell gives rise to four very small cells, each of which is, without further division, directly changed into the form characteristic of the spermatozoon. There seem to be no traces of the residual corpuscles which are supposed to be the homologues of the polar bodies.

No special cell could be detected to which the origin of the mesenchyme could be referred. The first traces of this tissue appear as soon as the ciliated cœloblastula becomes free-swimming; in the region of the future endoderm, one and then more cells push out into the segmentation cavity and become amœboid mesenchyme-cells. It appears to be certain that the development of Echinoderms is characterized by the absence of two bilaterally symmetrical primitive mesenchyme-cells. *Asterias vulgaris* seems to differ from *Astropecten* in that mesenchyme formation precedes and continues throughout the progress of invagination. As in most other Echinoderms the mesoderm of *Asterias* originates partly as a mesenchyme formation and partly as an enterocœl formation, though there is not in this case a sharp morphological distinction between them. Too much importance has been attached to the time of complete separation of the enterocœls, for it is subject to much individual variation.

A right and a left water-pore appear, and, though some investigators have regarded this as pathological, there is reason to believe that it is a true ontogenetic character, and of very considerable phylogenetic significance. With regard to the significance of the larval form of Echinoderms it is well known that two very divergent views are held; some regard it as having been cenogenetically acquired, others look on it as ancestral in character. Mr. Field points out that the cenogenetic modifications are of little importance when compared with those which appear to be ancestral. The total and very nearly equal cleavage, and the ciliated blastula offer both simple ancestral conditions and means for wide distribution; the mode of mesenchyme formation is probably more primitive than the formation of the third germinal layer in the form of mesoblastic bands; the derivation of this middle layer from any part whatever of the endoderm is antecedent to that condition where it is restricted to two special cells, the mesoblasts. The formation of enterocœls by archenteric diverticula is characteristic of ancestral forms, and in this larva are found the simplest conditions of complete enterocœls and archenteron, passing directly into corresponding parts of the adult. The bilaterally symmetrical water-pores cannot be supposed to be newly acquired characters, while the disappearance of the right pore may be explained by the subsequent connection between the two enterocœls by fusion in the preoral lobe.

The Echinoderm larva is a form which has developed along the phylogenetic line, and is in many ways differentiated and capable of free existence: cenogenetic additions are transparency as a protective adaptation, and the formation of long arms for protection, but primarily as a means of increased locomotor power. The greatest of the cenogenetic modifications is that whereby the typical larva acquires the different forms characteristic of the various groups, but these have, since the time of Johannes Müller, been known to be all modifications of a single typical form.

It seems pretty certain that the radial symmetry of Echinoderms has been derived from bilateral symmetry, through the influence of a sedentary mode of life. The metamorphosis we now see is an expression of the course of phylogeny, subjected to exceedingly great distortion. The author inclines, therefore, to the view that the ancestral Echinoderm arose by the adaptive modification of a more primitive free-swimming form rather than the one that a larval form has been acquired for the purpose of distribution.

Of the present groups of Echinoderms the earliest arising were the Synaptidæ, then the ancestors of other Holothurians, later the ancestors of Crinoids, and latest the ancestors of Echinids, Ophiuroids, and Asteroids. The intermediate forms between each group probably persisted but a very short time, and the corresponding stages have, for the most part, been eliminated from the ontogeny.

Most of the existing unstalked forms have been cenogenetically modified for a creeping life, the original excretory system assuming the locomotor in addition to the more early acquired sensory and respiratory functions. The early appearance of radial symmetry in the free swimming larva, shown by the radial outpushings of the hydrocœl wall at that stage of the ontogeny which is generally spoken of as the beginning of metamorphosis, may be regarded as precocious formation for the purpose of abbreviation of development. This last is carried to an extreme by the so-called viviparous Echinoderms.

Development of Amphiura squamata.*—Mr. E. W. MacBride, who has already published a preliminary notice of the results of his investigations,† states that the following are the principal results to which he has been led. The primitive germinal cells are peritoneal, and from a portion of the rudiment which gives rise to them there is developed the ovoid gland, which is a solid organ. The axial and aboral sinuses are involutions of the cœlom, and have no connection with the ampulla of the stone-canal or each other. The genital rachis is an outgrowth from the ovoid gland into the aboral sinus; both kinds of cell, germinal and interstitial, which are found in the genital rachis, are formed in the ovoid gland. The germinal cells are formed from peritoneal cells directly, and there is no evidence of the transformation of the special cells of the ovoid gland into primitive germ-cells.

From these observations it follows that Echinoderms agree with other Cœlomata in the origin of their genital cells; these have at first an unsymmetrical position in Echinoderms, and afterwards take on a radially symmetrical disposition in correspondence with the secondarily acquired radial form of the body; this is in agreement with the classifications proposed by Prof. Jeffrey Bell ‡, in which the Echinoderma are divided into the two groups of Anactinogonidiata and Actinogonidiata. The origin of the genital cells adjacent to the stone-canal suggests a comparison of the origin of the same kind of cells near the nephridia of Annelids, though the author allows that the homology of the stone-canal with a nephridium has yet to be proved.

With regard to the hæmal system described by Prof. Ludwig,

* Quart. Journ. Micr. Sci., xxxiv. (1892) pp. 129–53 (3 pls.).
† See this Journal, 1892, p. 621. ‡ Op. cit., 1891, p. 662.

Mr. MacBride denies its existence; he points out that what looks like a blood-vessel is limited by no cell-layer from the nerve-fibres below, and its boundary towards them is often jagged and uneven, while the angles of the outline run out into vertical fibres, and convey the impression that the so-called blood-vessel is merely composed of the cell-plasma of two or three rather larger dorsal ganglion-cells which are prolonged into these fibres. As to the so-called branches of the hæmal system which go to the alimentary canal, they appear to be nothing more than mesenteric bridles.

Morphology of Skeleton of Starfishes.*—Prof. E. Perrier finds that the arm of *Hymenodiscus* has its skeletal parts so reduced as to make it impossible as a point of departure. He starts, therefore, with the arms of *Brisinga* and *Odinia;* in *Labidiaster* there is further complication; the author recognizes adambulacral plates connected with one another by five longitudinal rows of small plates; the third and fifth plate of each have a spiral form, and may be called the ventral marginal and dorso-marginal, while the seventh plate, which occupies the mediodorsal line of the arms may be called the carinal. Here we have the fundamental parts of the arms of Starfishes. The term *ventro-lateral* is applied to the piece between the adambulacral and the ventral marginal; *intercalary* to those which unite the ventral and dorsal marginals; *dorsolateral* to those which unite the latter with the carinals; and *reticular* to the pieces set in longitudinal or oblique rows which pass from one arch to another.

All the modifications of form seen in Starfishes depend solely on the relative development and numerical relations of their different systems of plates. When the ventral and dorsal arches are formed in the same way from the base to the tip of the arms, these, which are cylindrical or conical, are sharply distinguished from the disk, which is circular. When the ventral and dorsal arches are more developed at the base than at the tip, there is a tendency for the disk to take on a pentagonal form.

Prof. Perrier thinks it is permissible to regard the arms of Starfishes as primitively formed of successive segments, and that the relationship so often noticed between Echinoderms and Vertebrates receives support from this view.

Holothurians collected by the 'Hirondelle.'†—Dr. E. von Marenzeller has a preliminary notice on the Holothurians collected by the Prince of Monaco during the voyages of the 'Hirondelle.' The new species are *Holothuria lentiginosa*, *Benthodytes janthina*, *Peniagone azorica*, and *Chiridota abyssicola*. The ranges of some new species are increased, the southern *Cucumaria abyssorum* having been found in the Atlantic, and the littoral *Synapta digitata* taken at a depth of 2870 metres.

Cœlentera.

Larva of Euphyllia.‡—Prof. A. C. Haddon gives an account of a newly hatched larva of *Euphyllia rugosa* which he observed in the Torres Straits. The only differences in the mesenteries between this larva and

* Comptes Rendus, cxv. (1892) pp. 670–3.
† Bull. Soc. Zool. France, xvii. (1892) pp. 64–6.
‡ Scientific Proc. R. Dublin Soc., vii. (1892) pp. 127–36 (1 pl.).

the corresponding stage of many Actiniæ is that the sulcular directives, although they reach the œsophagus, are devoid of mesenterial filaments. Alternating with the mesenteries are large ridge-like vesicular outgrowths from the endoderm, into which the endoderm of the mesenteries passes gradually. At the angles between the mesenteries and the ridges there are numerous Zooxanthellæ. It is these Algæ that give rise to the twelve pairs of dark longitudinal lines which are so conspicuous in the living larvæ. The mesoglœa is an apparently homogeneous jelly-like substance, which is mainly, if not altogether, endodermal in origin.

The ectoderm of the body-wall forms at the aboral end of the body a disk-like patch of deep closely-set cells, and forms the seat of attachment of the sessile larva; in the column there is, in addition to and beneath the ordinary narrow cells, a deeper granular or "nervous" layer, and there is an immense number of thread-cells. At the oral apex the granular layer becomes so much thickened as to practically constitute the whole of the ectoderm. It seems probable that the mesenterial filaments are derived from the ectoderm of the œsophagus. In the first pair of mesenteries the ectoderm of the stomatodæum applies itself directly to the body-wall, and, pushing aside the endoderm, comes into contact with the basement membrane of the ectoderm of the column. The succeeding mesenteries, on the other hand, first project from the body-wall, come into contact with the stomatodæum from above downward, and push before them a portion of the reflected ectoderm which has grown round the free end of the stomatodæum and up its cœlenteric surface.

New Species of Epizoanthus from the Azores.*—Dr. E. Jourdan describes an *Epizoanthus*, remarkable for its size, which he calls *E. Hirondellei;* it is most nearly allied to *E. paguriphilus*. The polyp may measure 0·05 cm. by 0·03 cm. Eight polyps unite to form a colony, and are completely imbedded in the cœnenchym. It was taken at a depth of 1266 metres near the Azores, and the inhabitant of the shell was *Pagurus pilosimanus* or the species which lives with *E. paguriphilus*.

Sense of Taste in Sea Anemones.†—Dr. W. Nagel has shown by numerous experiments that species of *Adamsia*, *Actinia*, *Aiptasia*, *Heliactis*, *Anemonia*, and *Cerianthus* have a sense of taste in the tentacles. These organs are also sensitive to influences of touch and temperature, and are therefore what the author calls *Wechselsinnesorgane*.

Historical Note as to Theories of Coral Reefs.‡—Dr. C. Ph. Sluiter points out that the essay on coral islands contained in Kotzebue's book of travels and usually credited to Chamisso was the work of Eschscholtz, while Chamisso's own views were entirely different, and not of any value.

Structure and Development of Cunina Buds.§—Dr. O. Maas begins with an account of the varied opinions which have been held in regard to the nature and relations of *Cunina*. He proceeds to describe a stock

* Bull. Soc. Zool. France, xvi. (1892) pp. 269–71.
† Zool. Anzeig., xv. (1892) pp. 334–8.
‡ Tom. cit., pp. 326–7.
§ Zool. Jahrb., v. (1892) pp. 271–300 (2 pls.).

which he obtained from the stomach cavity of *Geryonia* (*Carmarina*) *hastata*. The stock was bifurcated, and covered with Medusa-buds of various ages. Some of these were liberated, and swam about in the characteristic Narcomedusa fashion.

The stock consists of an axial part and the medusæ which bud from it. The axis is not a simple tube, but exhibits irregular ramifications. F. E. Schulze's observations on the minute structure were confirmed. Individual buds at different stages were carefully disposed and sectioned, and a series is described. It is difficult to refer the form to any of Haeckel's families. In the absence of an annular canal, it is like one of the Solmaridæ, but is distinguished by the *Hörspangen* and other features. In other ways it approaches the Cunanthidæ, but among these it seems almost to require a new genus.

It is difficult to explain the relative simplicity of this form as the result of degeneration, for the gastro-vascular system is from the first a simple stomach, and of circular canal and radial canals there is not a hint. The position of the tentacles, which arise at some distance from the margin, developing along with and between the lappets, is another remarkable peculiarity. The author inclines strongly to the interpretation that a planula, sexually produced, settles down in the tissue of the *Geryonia*, and forms a stock which produces Medusæ by budding; in short, that there is a simple alternation of generations. A further consideration of this alternation of generations leads Dr. Maas to the view that the relations of the Narcomedusæ to the other Craspedota are less close than has been hitherto supposed; in fact, that Narcomedusæ and the other Craspedota are only connected by a common root.

Porifera.

Flask-shaped Ectoderm and Spongoblasts of one of the Keratosa.* —Mr. G. Bidder describes the ectodermal cells of what is apparently *Cacospongia scalaris* as having a flask-shaped form; treatment with dilute osmic acid, followed by nitrate of potash and nitrate of silver, shows that the cells open on the surface in the centre of the silver areas; the only nucleus connected with the silver area is the one lying in the base of the pendent cell-body. This completely justifies the inability of Schulze and other trustworthy investigators to find nuclei at a more superficial level, where the "flat epithelium" was usually supposed to exist.

The spongoblasts of this sponge form a continuous tissue with the ectoderm cells, which they resemble in form and character. The appearance seen suggests that the apex of a conulus is a locus of attraction for ectoderm cells, and that the fibre is nothing more than the concentrated cuticle of a large number of such cells poured out round an intrusive foreign object.

After a short discussion of Mr. Minchin's recent observations Mr. Bidder states that it seems to be an established fact that in all groups of Sponges the flask-shaped epithelium does occur; it, and not a flat epithelium such as lines the canals, is the structure most commonly to be met with.

* Proc. Roy. Soc. Lond., lii. (1892) pp. 134–9 (3 figs.).

Protozoa.

Foraminifera from Chalk of Taplow.*—In a report on the Microzoa from the Phosphatic Chalk of Taplow, Mr. F. Chapman enumerates ninety-eight species of Foraminifera, five of which are new to science, while thirty are new to the Chalk fauna; of these last two were hitherto known only from recent deposits.

Notes on Coccidia.†—MM. A. Railliet and A. Lucet have been engaged in the study of the Coccidia of some of the domestic animals. *Coccidium perforans* appears to be almost confined to the intestine of Man and the Rabbit; *C. tenellum* sp. n. is found in the Chicken, and probably also in the Pigeon, Goose, and Duck, and seems to be limited to the intestine. *C. truncatum* sp. n. has been found in the kidneys of the domestic Goose, where it is expelled into the urine. *C. bigeminum*, lately described by Stiles, but detected many years before by Finck, exists under three, if not four, varieties.

Sarcosporidia and Parasitic Sacs in Body-cavity of Rotifers.‡—Dr. Bertram describes *Sarcocystis platydactili* sp. n. in the muscle-fibres of the Gecko, *S. miescheri* Ray Lankester, *S. tenella* Raill, and *Balbiania gigantea* Raill. He also describes microscopic parasites found (in September and October) within the body-cavity of three species of *Brachionus*. They appear to resemble zoosporangia of *Chytridium*.

* Quart. Journ. Geol. Soc., xlviii. (1892) pp. 514–8 (1 pl.).
† Bull. Soc. France, xvi. (1891) pp. 248–50.
‡ Zool. Jahrb., v. (1892) pp. 581–604 (3 pls.).

BOTANY.

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

a. Anatomy.

(1) Cell-structure and Protoplasm.

Structure of the Cell-wall.*—Dr. L. Buscalioni has studied the structure and mode of growth of the cell-wall, especially in the endosperm and suspensor of *Phaseolus multiflorus*, and in the seeds of *Corydalis cava*.

Before fertilization, the wall of the embryo-sac of *Phaseolus* displays at certain spots, slight thickenings and fringe-like projections into the sac, and the young cells of the suspensor have similar internal projections; at these spots the protoplasm becomes denser, and exhibits, after a time, the reactions of lignin. While this change in the protoplasm is proceeding, the cell-wall becomes gradually thicker, and both it and fine granulations which appear on its surface are stained blue by chlor-zinc-iodide, and the sharp distinction between the cell-membrane and the protoplasm disappears; the microsomes formed at the spots where the new cell-walls are to appear are gradually converted into cellulose. Rows of cellulose-granules now make their way further into the cell-cavity, and gradually assume the form of branching anastomosing rodlets, which are still to be made out in the fully formed cell-wall. Besides these rodlets, crescent-shaped lumps and free granules of cellulose are formed.

The increase in thickness and surface of the cell-wall is brought about neither by intussusception nor by apposition, but by transformation from protoplasm in contact with the membrane; it can take place only when there is contact with already formed cellulose. The microsomes are transformed directly into grains of cellulose; the hyaloplasm into the uniting substance which causes the striation and lamination. It is not uncommon for portions of protoplasm to become enclosed within the masses of cellulose.

The structure of the ovule of *Corydalis cava* is described in detail at the time when it is ready for impregnation. Its coat at this period consists of an epiderm, a layer of cubical cells, and a layer of cells elongated tangentially, and there is also a large aril. In the process of cell-division in these layers, the phenomena correspond in all essential points to those witnessed in the embryo-sac of *Phaseolus*. The microsomes of protoplasm, which are arranged in rows along the inner surface of the cell-walls, are gradually transformed into cellulose-grains, beginning from the centre; and these grains are converted, in their turn, into rodlets, or into new layers of cell-wall superposed on those already in existence. The author believes that the purpose of these rodlets is to give strength to the cells in which they are formed.

* Malpighia, vi. (1892) pp. 3–40, 217–28 (3 pls.).

Structure of the Resting Nucleus.*—Dr. F. Krasser has investigated the structure of the resting cell-nucleus in a number of flowering plants (Monocotyledons and Dicotyledons), and in *Pteris serrulata* and *Spirogyra*, both in the living state and with the use of various fixing and staining reagents. He finds it to be always composed of granular elements; in the cases observed the granules were always distinct, and usually arranged in short stellate rows. They were most easily detected in the interior, with greater difficulty in the membrane of the nucleus and in the nucleole; in the two latter cases there was not always a distinct differentiation of granules. The nuclear sap is present only in those resting nuclei which, like some of those of *Phajus*, have a wide-meshed staining framework. The granules belonging to the nuclear sap are revealed by staining with cyanin. Some of the granules appear to be identical with Pfitzner's chromatin-granules. With double-staining the granules, as a rule, take up only one of the two stains, so that they may be distinguished as erythrophilous and cyanophilous. In two cases staining showed the nuclear membrane to be composed of two lamellæ.

Physode, an Organ of the Cell.†—Under the term *physode*, Herr E. Crato describes a structure which he finds especially in the cells of *Chætopteris plumosa*, an alga belonging to the Phæosporeæ. The physodes are vesicular bodies occurring within the protoplasm-filaments, which they distend more or less; they consist of a protoplasmic envelope and of strongly refractive fluid contents. In the cells towards the apex of a shoot the protoplasm is differentiated into a parietal utricle, and into flakes and threads, the latter of which permeate the cell somewhat uniformly, forming a network of hexagonal meshes. The threads of this mesh are from 0·33 to 0·5 μ thick; and these meshes are again permeated by other finer or coarser threads; these may be not more than 0·1 μ thick. Chromatophores and physodes occur in both kinds of thread, the former being found especially in the neighbourhood of the cell-wall, the physodes more towards the interior, and chiefly near the nucleus, which is often concealed by physodes and chromatophores. The physodes are usually of a round or elliptical form, and vary in size from that of the chromatophores to almost invisible refractive particles. They never leave the protoplasm-filaments, and have been hitherto included under the microsomes, of which they form the largest portion.

The physodes are endowed with a characteristic amœboid movement, which is sometimes of a pulsating nature. They are constantly shifting their position within the filaments, sometimes returning again to the same place, sometimes moving even into another mesh. This is due to a power of motion of their own, and not simply to the streaming of the protoplasm. They are not unfrequently branched, the branches being still always enclosed within very fine threads of protoplasm.

The physodes do not multiply by division, but are formed fresh within the protoplasm-threads by the separation of drops of a strongly refractive substance. In the formation of the zoospores of *Chætopteris* their contents are mostly used up, and fresh ones are formed as the

* SB. K. Akad. Wiss. Wien, ci. (1892) pp. 560–83.

† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 295–302 (1 pl.).

zoospores escape. They are but little affected by external agencies. The author has found these structures not only in the Phæosporeæ, but in all other brown or green algæ and flowering plants examined.

Active Albumen in Plants.*—Herr O. Loew sums up the arguments in favour of the existence of an active albumen in the living cell. The living protoplasm is, he states, composed of proteids entirely different from the ordinary soluble proteids, as well as from the proteids of dead protoplasm. This is shown by the property of respiration possessed by the living cell. On treating living plant-cells with dilute solutions of ammonia or organic bases or their salts, remarkable changes are observed, consisting either in the formation of numerous minute granules, as is the case on the application of most of the bases, or in the production of small globules flowing together to make relatively large drops of a substance of high refractive power, as happens on the application of weak bases like caffein or antipyrin; these latter are the *proteosomes*. They give the principal reactions of albuminous bodies, but contain in most cases an admixture of small quantities of lecithin and tannin. On the other hand, bases do not act upon the albumen of dead cells, nor upon ordinary dissolved albumen. The proteosomes have the property of reducing dilute silver solutions in the absence of light, but lose this property on the action of acids. Soon after the death of the protoplasm, the proteosomes lose their characteristic properties, becoming hollow and turbid.

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

Chemistry of Chlorophyll.†—Dr. E. Schunck gives a *resumé* of researches into the nature and constitution of chlorophyll since 1889. Gautier's "crystallized chlorophyll" he regards as a product of decomposition formed during the process. Tschirch's "phyllocyanic acid" is merely impure phyllocyanin. The "phylloxanthin" of Fremy is a mixture of several colouring matters; true phylloxanthin resembles phyllocyanin so closely in its properties that they are probably isomeric substances. Pringsheim's "hypochlorin" appears to be identical with phylloxanthin.

Vegetable Lecithin.‡—Herr A. Likiernik finds, in the seeds of vetches and lupins, a substance identical in its properties, and in its products of decomposition, with the lecithin found in animal organisms. It was accompanied by lupeol and phaseol, bodies analogous to the cholesterins. Lupeol consists partly of a substance which, with the same amount of carbon, contains two atoms less of hydrogen than cholesterin; in the lupin it appears to replace the cholesterin of other Leguminosæ.

Calcium oxalate in the Bark of Trees.§—According to Herr G. Kraus, the calcium oxalate which is contained in large quantities in the bark of various trees is a reserve deposit, and not an excretion; it is redissolved in the spring and summer, passing into the cell-sap.

* Nature, xlvi. (1892) pp. 491–2.

† Ann. Bot., vi. (1892) pp. 231–44. Cf. this Journal, 1892, p. 381.

‡ 'Ueb. d. pflanzliche Lecithin u.s.w.,' Zurich, 1891. See Bot. Centralbl., lii. (1892) p. 19; and Ber. Deutsch. Bot. Gesell., xxiv. (1891) pp. 71–4.

§ Ann. Agron., xviii. pp. 271–2. See Journ. Chem. Soc., 1892, Abstr., p. 1370.

(3) Structure of Tissues.

Thickening of the Wall of Cambium-cells.*—Herr F. Krüger has made a series of observations on this subject, chiefly on *Sambucus nigra*, though the results were essentially the same in all cases, whether with Dicotyledons, Monocotyledons, or Gymnosperms, woody, herbaceous, succulent, or annual plants, aerial organs or roots.

The thickenings, which appear lens-shaped in tangential sections, are bands on the radial walls; they are separated from one another by roundish pits which do not include the whole breadth of the wall, and correspond to the thin spots on the tangential section. Though less conspicuous than in the winter, they are present also in the summer. These thickenings occur not only in the closed cambium-layer, but also in the cambium-plate of the still isolated bundles, and can be followed back into the procambial bundles. They are to be met with also in the whole of the young growth, and in the bast-parenchyme. In the cells of this tissue there is a differentiation between the outer and inner portion of the thickenings, due to the formation of mucilage, and intercellular spaces may arise.

The sieve-plates and the sieve-plate system of the longitudinal walls are derived directly from the thin spots of the cambium. Both simple and bordered pits appear on the radial walls of the vessels, tracheids, and prosenchymatous xylem-cells, as also directly from the thin spots of the cambium. On the other hand the sieve-plate system of the tangential walls of the sieve-tubes, and the simple and bordered pits on the tangential walls of the prosenchymatous xylem-cells, tracheids, and vessels, are secondary phenomena, and have no direct connection with the thickenings of the cambium.

Resin-canals of the Leaves of Abies pectinata.†—According to M. J. Godfrin there are always, in the branches of *Abies pectinata*, eight longitudinal secreting canals situated in the cortex, and belonging to the stem; these he calls the cauline canals. In their lower part these canals branch abundantly. In the very young spring-branches, or at the summit of those which are of a greater age, the canal-system of the leaf is separated from that of the stem; but later, without its being possible to indicate any exact time, the foliar canals unite with those of the stem by means of ramifications proceeding from the latter. The author regards the foliar canals of *Abies pectinata* as homologues of the resinous glands of the Cupressineæ.

Root-system of Mikania scandens.‡—Mr. W. W. Rowlee describes a peculiar structure in the root of this plant. In sections are seen four modified cells, two of which belong to the endoderm, and two to the row of cells just outside. These cells always lie in contact with the phloem-cells, and are so arranged as to enclose a rectangular intercellular space of considerable size and definite shape. They have large nuclei, which are always on the side of the cell next to the intercellular space; and these spaces extend to very near the growing-point of the root, thus

* Bot. Ztg., l. (1892) pp. 633-40, 649-57, 665-73, 681-8, 702-8 (1 fig.).
† Bull. Soc. Bot. France, xxxix. (1892) pp. 196-9.
‡ Bot. Gazette, xvii. (1892) pp. 276-7.

forming long tubes. The whole appears to be a contrivance for the promotion of aeration.

(4) Structure of Organs.

Resemblances in Habit between Plants belonging to different Genera.*—Dr. C. Reiche points out the frequent occurrence of a close resemblance in external appearance between (1) two species belonging to different genera of the same order, (2) two species belonging to widely separated genera. This resemblance must be largely due to the influence of external conditions, and is not an example of mimicry in the true sense of the word; and the author suggests the need of caution in explaining similar resemblances in the animal kingdom as necessarily the result of mimicry.

Structure of Pollen.†—Dr. P. Biourge has investigated the structure of pollen-grains obtained from a large number of plants—Dicotyledons, Monocotyledons, and Gymnosperms—especially in relation to their chemical constitution. He finds that pollen-grains always have two coats, an extine and an intine. Among Dicotyledons they present two general types,—(1) Spherical, with numerous pores and no furrows; (2) ellipsoidal, with three pores; the ellipsoid may be flattened or elongated, and the pores vary from the rounded to the elongated form, or may pass into furrows, often reaching the poles. In Monocotyledons simple grains have usually only one furrow; the primitive form is that of a quarter of an orange. In both groups compound grains occur. The extine is composed of one or two layers, the outer of which is usually sculptured; the number of pores and furrows varies, sometimes even in the same species. The intine is always continuous; if there are pores, it is composed of several layers, of which one is always closed; between the pores there are frequently thickenings. The wall of the pollen-tube is always formed by a drawing out of the intine; it may be simple or composed of several layers.

The extine is rarely composed entirely of cellulose, and is usually cutinized; while the intine is composed of pure cellulose, or of pectic substances, or of a mixture of the two; there are often special layers of callose. The wall of the pollen-tube is generally composed of cellulose. The wall of the pollen-mother-cells is thickened by the apposition of secondary layers before the division into tetrads; and the same takes place in each daughter-cell. The extine appears before the intine; the innermost layer of the latter frequently only a short time before dehiscence.

Staminal Hairs of Thesium.‡—Miss M. F. Ewart describes the hairs which are found attached to the perianth-tube behind the stamens in various species of *Thesium* and in other allied genera of Santalaceæ. These hairs are of two kinds—those which are comparatively short and thick, and directed downwards towards the base of the style, and those which are long and slender, and directed upwards towards the top of the anther. The hairs are unicellular, and contain a yellowish-green semi-fluid secretion which gives the microchemical reactions of a balsam: they have also a basal cushion and a small rounded terminal cap. They

* Verhandl. Deutsch. Wiss. Ver. Santiago, ii. (1892) pp. 243–5 (1 pl.).
† La Cellule, viii. (1892) pp. 45–76 (2 pls.).
‡ Ann. Bot., vi. (1892) pp. 271–90 (1 pl.).

appear to be modified cells of the epiderm of the perianth, which have become enormously elongated. Their function appears to be undoubtedly connected with pollination. They serve either to collect the pollen-grains or to prevent the visiting insect from passing behind the stamens, and thus missing the stigma. A proposed classification is appended of the species of *Thesium*, according to the structure of the flower.

Structure of the Integument of the Seed of Papilionaceæ.*—Sigg. O. Mattirolo and L. Buscalioni have examined the structure of the testa of the seed in a number of species of Papilionaceæ, that of *Phaseolus* being described in detail.

The testa consists of three layers—the layer of Malpighian cells (wax, clothing layer, or "linea lucida"), the layer of columnar cells, and a lower layer. The outermost layer does not correspond to the cuticle, but to the clothing-layer of the intercellular spaces. Between the deeper layer of the testa and the endosperm is a separating layer, the cells of which are united by strings of protoplasm; sieve-tubes were found in the vascular bundle of the funicle. In the chilary layer of the seed is a small pit, bounded by two motile lip-shaped structures, which the authors call the *chilarium*. The hygroscopic separation of these structures causes the rupture of the testa. The purpose of the "linea lucida" appears to be the regulation of the absorption of water. The so-called "twin tubercles" of the seed appear to exercise a pressure on the vascular bundle which runs beneath them, especially on its phloem-portion, and thus prevent an excessive flow of nutrient material for the seed. The micropyle facilitates the entrance of fluids and gases into the interior of the seed.

Seedlings.†—Sir John Lubbock gives in these volumes an account of a long series of experiments on the growth and development of seedlings, principally of Dicotyledones, especially in relation to the connection between the form and structure of the cotyledons and that of the permanent leaves. After a general introduction, the phenomena connected with the germination of a very large number of species, arranged in their natural orders, are described. The various forces which influence the growing plant are discussed, and the author arrives at the general conclusion that, in the great majority of cases, it is the form of the fruit that governs that of the seed, and the form of the seed that determines that of the cotyledons.

Branching Palms.‡—Mr. D. Morris enumerates the tribes and genera of palms in which branched or forked stems occur. Branching is habitual in some species, and occasional in other species, of *Hyphæne*, and is also occasional in certain species of *Rhopalostylis*, *Areca*, *Dictyosperma*, *Oreodoxa*, *Leopoldinia*, *Phœnix*, *Nannorhops*, *Borassus*, and *Cocos*. The branching is frequently the result of injury to, or destruction of, the terminal bud, causing the development of adventitious or axillary buds below the apex, which produce branches. In some species it is

* Mem. R. Accad. Sci. Torino, xlii. (1892) 186 pp. and 5 pls. See Bot. Ztg., l. (1892) p. 694. Cf. this Journal, 1890, p. 625.

† 'A Contribution to our Knowledge of Seedlings,' London, 8vo, 1892, 2 vols., 608 and 646 pp. and 684 figs.

‡ Journ. Linn. Soc. (Bot.), xxix. (1892) pp. 281-98 (7 figs.).

caused by the replacement of flower-buds by branch-buds; the branches are then usually short, and are arranged alternately along the stem; the terminal bud is apparently neither injured nor destroyed. Palms that usually produce suckers at the base are rarely branched at or near the apex. In no instance has a branched stem been recorded in a monocarpic palm.

Dimorphism of the Root-tubercles of the Pea.*—Herr B. Frank states that there are on the roots of *Pisum satirum* two different kinds of tubercle. The ordinary kind are small, nearly hemispherical, usually unbranched, and not more than from 1–2 mm. in diameter; these are mostly situated on the lower part of the tap-root and on the lateral roots. They contain the ordinary bacteroids. In addition there occur, chiefly on the upper part of the tap-root, but also on the lateral roots, much larger much branched or lobed tubercles, united into large coral-like masses as much as 1·5 cm. in diameter. The chief distinction between these and the ordinary tubercles is in the nature of their contents, a peculiar kind of bacteroid, composed not of proteids, but of amylodextrin, as is shown by the greater refrangibility and by micro-chemical reactions. The author proposes to term the two kinds *albuminoid-* and *amylo-dextrin-tubercles*. While the former contain nearly 7 per cent., the latter contain not quite 5 per cent. of nitrogen. The anatomical structure and the function of the two kinds of tubercle appear to be identical.

Herr H. Moeller† denies that the two kinds of tubercle, which occur also in *Trifolium*, are in any way essentially distinct from one another. The larger kind are simply older tubercles of the ordinary kind in which fatty degeneration of the proteids has taken place. He further states his conviction that the "filaments" of Frank and Prazmowski are much-branched arms of an invading zooglœa of bacteria, which become enclosed as a foreign substance by a cellulose-membrane, in consequence of the irritation of the protoplasm. It is the plant that forms this membrane, and thus endeavours to protect itself against the invading parasite.

In reply Herr Frank‡ points out that Müller's objection applies not to *Pisum*, but to *Trifolium*, in which the two kinds of tubercle do not exist. He now states that the granular contents of the bacteroids which are stained reddish-brown by iodine are not confined, as he before supposed, to the tubercles of *Pisum*, but occur also in those of other Papilionaceæ. In *Pisum* they are confined to one kind of tubercle.

In a further communication§ Herr Moeller states that he finds the same results with *Pisum* as with *Trifolium*.

Structure of Lathræa.‖—Dr. E. Heinricher has examined several points in the structure of this genus, especially in *L. squamaria* and *clandestina*.

The capsule of *L. clandestina* is a "sling-fruit," opening with considerable force to expel the seeds, which are reduced to not more than four in number. The wall of the capsule is composed of two layers, one

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 170–8 (1 pl.).
† Tom. cit., pp. 242–9. ‡ Tom. cit., pp. 390–5. § Tom. cit., pp. 568–70.
‖ SB. K. Akad. Wiss. Wien, ci. (1892) pp. 423–77 (2 pls. and 2 figs.).

of which is a swelling, the other a resisting tissue. The force for bursting the capsule resides in the turgor of the cells of the former layer, assisted by the remarkable extensibility of its cell-walls. This tissue has no intercellular spaces. *L. squamaria* has also a "sling-fruit," but the mechanism for its bursting is different. When the fruit is ripe the epidermal cells of the placenta entirely lose their epidermal character, and become changed, some of them into thin-walled, others into spirally thickened cells, which assist in the detaching of the ripe seeds from the placenta.

In all the species of *Lathræa*, all the underground organs, both rhizomes and scale-leaves, are provided with stomates; in *L. clandestina* there are no stomates on the aerial organs; in *L. squamaria* they occur in the bracts, sepals, and carpels, but are for the most part functionless. Crystalloids occur both within and outside the cell-nucleus in *L. squamaria*, but the two kinds are never found in the same cell; the latter in the epidermal cells of the corolla. In the interior of the corolla of *L. clandestina* is found a ring of stiff unbranched septated hairs which still contain protoplasm although their walls are thickened in an annular or spiral manner.

β. Physiology.

(1) Reproduction and Embryology.

Embryo-sac of Myosurus.*—Mr. G. Mann has studied in great detail the development and structure of the embryo-sac of *Myosurus minimus*. Among a great variety of observations recorded, the following are the more important.

Division of the archespore into four cells appears to be the rule; though in ovules which are formed at a later period the number is only three. The gelatinous swelling of the walls of these cells is in every respect analogous to that which takes place in the sporocyte-walls of other sporanges, e. g. in the pollen-sacs of Angiosperms, in *Selaginella*, &c. Of several original archespores only one performs its function of giving rise to a number of sporocytes, and of these sporocytes only one completes its function of giving rise to spores. The physiological sporocyte or embryo-sac-cell is at first of the same size as the non-physiological sporocytes, but is soon greatly enlarged. At a later period food-material appears to pass, through the breaking down of cells, to the cells lying at the micropylar end of the embryo-sac, i. e. to the oosphere and synergids. The author regards the contents of the mature embryo-sac as consisting of eight sexual (female) cells. Of these only one, the oosphere, is physiologically sexual; two, arising from different spores, the micropylar and antipodal primordial cells, conjugate, and give rise to the primary endosperm-cell; the remaining five undergo no further development. The embryo-sac, therefore, is not a megaspore; but its contents divide into four megaspores, two situated at the micropylar, and two at the antipodal end, and these again divide into the above-named eight female cells. Although the two synergids as a rule undergo no further development, yet they may, under special circumstances, perform the physiological function of oospheres. The eight female cells derived from the embryo-sac corre-

* Trans. Bot. Soc. Edinburgh, 1892, pp. 351–428 (2 pls.).

spond to the eight male reproductive cells which develope from one pollen-mother-cell. The primary endosperm-cell must be regarded as a true embryo resulting from the union of two sexual cells, but destined as a storehouse of food-material for the impregnated oosphere.

The structure of the nucleus and nucleoles of the oosphere is described in detail, and the stages in the formation of the endosperm cell, including the amœboid movements of the cell-plasms of the two primordial cells, which lead to their conjugation. The directing spheres or tinoleucites play only an indirect part in the actual process of impregnation.

The concluding portion of the paper is occupied by a discussion of the various theories of fertilization, and by a comparison of the phenomena in the animal and vegetable kingdoms.

Sexual Organs of Flowers.*—Herr A. Schulz publishes a number of observations on the flowers of plants usually regarded as unisexual. In *Alnus glutinosa* hermaphrodite flowers or transitional forms are to be found at the base of all the male catkins. Hermaphrodite flowers also occur in the birch, though less frequently; very rarely in the hazel; in the oak there are frequently ovaries at the base of the male catkins, and rudiments of stamens in the female flowers. In the ash we have all kinds of condition—male, female, and hermaphrodite flowers, and monœcious, dicœcious, and polygamous individuals. This tree is probably on the road to becoming completely dicœcious.

Hybridization of the Vine.†—M. A. Millardet gives detailed practical instructions for the hybridization of the vine and the culture of the hybrids, preceded by some general remarks. The so-called hybrid vines which are cultivated in Europe are not true hybrids, i. e. results of the crossing of distinct species, but spring from the crossing of different races of the same species, *Vitis vinifera*.

In the native state, both *V. vinifera* and other species of the genus have two kinds of flower, hermaphrodite and male, the female organ being subject to all degrees of abortion in the latter. There is a remarkable difference in the stamens of the two kinds of flower: in the former the filaments are short and curved backwards, so as to remove the anther as far as possible from the stigma; in the latter they are long and erect. In the cultivated varieties, however, all of which have only hermaphrodite flowers, the filaments are long and erect, as in the male flowers of the wild plant. The pollen-grains from the short curved stamens will not germinate in a solution of sugar; but the author states that they will germinate on the stigma. In the wild state the vine is anemophilous, though the flowers have a powerful odour, the purpose of which is obscure. In the cultivated state two small Coleoptera, *Dasytes griseus* and *Scraptia fusca*, were observed abundantly on the flowers, and they may also probably take some part in the pollination. The author states that it is beyond question that in the vine it is the male parent that exercises the preponderating influence on the hybrid.

Mr. S. A. Beach‡ enumerates eight American species of vine, and their hybrids and crosses, in which he has observed self-pollination.

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 303–13, 395–409.

† Mém. Soc. Sci. Phys. et Nat. Bordeaux, ii. (1891) pp. 301–38 (6 figs.).

‡ Bot. Gazette, xvii. (1892) p. 282.

Crossing of Cultivated Plants.*—Herr W. Rimpau has experimented on the crossing of some of our most common agricultural plants. If a new form exhibits great variability in its descendants, it is probably a hybrid; while if its descendants maintain great constancy, it may be regarded as a spontaneous variety. Of wheat the author describes ten artificial and nine natural hybrids; he obtained a fertile hybrid between wheat and rye. Of barley, two artificial and six natural hybrids are described; in no case could a two-rowed form be fertilized by the pollen of barley with a larger number of rows. Of oats five natural, but no artificial hybrids were obtained. Peas produce very few natural hybrids; with the beet crossing is much easier.

Pollination of the Primrose.†—Dr. R. Cobelli gives some measurements of the length of the corolla-tube and other points in the long- and short-styled forms of the primrose. He believes that, whether cross-fertilized or self-fertilized, pollination cannot take place without the agency of insects, and that these are chiefly *Thrips* and small Coleoptera; *Goniopteris Rhamni* is also efficacious in effecting cross-pollination.

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

Effect of the Electric Light on Vegetation.‡—M. G. Bonnier has made experiments on the effect of the electric light on the growth of a number of herbaceous plants, the illumination being kept up continuously for a period of seven months. He finds that, under glass, the electric light greatly accelerates the growth of herbaceous plants, producing an intense green. The structure of the organs is at first strongly differentiated; but if the light is intense and prolonged for months, the new organs formed in the plant present remarkable modifications of structure in their various tissues, and are less differentiated, but always rich in chlorophyll. The direct electric light is, by its ultra-violet rays, injurious to the normal development of tissue, even where the lamps are at a distance of more than three metres.

When trees (*Pinus austriaca*, *P. sylvestris*, beech, oak, birch) are exposed to a strong electric light, without interruption, by day and night, the plant appears to become exhausted by the continuous respiration, and the development of the tissues is feebler. Intervals of bright electric light and of darkness produce a similar effect, though not so marked.

Influence of Position on the Form of Organs.§—Prof. J. Wiesner distinguishes between anisotropy, or a change in the direction of growth due to external forces, and *anisomorphy*, or a change in the form of an organ caused by its position in relation to the horizon, or to its mother-axis. One of the most common illustrations of anisomorphic organs is anisophyllous leaves. With regard to the direction of growth, organs may be either orthotropous (vertical), hemiorthotropous, or clinotropous. The author further defines the following kinds of unequal growth: *epitrophy*, when the growth of the cortex or wood is greater on the upper

* 'Kreuzungsproducte landwirthschaftlicher Cultur-pflanzen,' Berlin, 1891, 14 pls. See Bot. Centralbl., li. (1892) p. 359.

† SB. K. K. Zool.-Bot. Gesell. Wien, xlii. (1892) pp. 73–8.

‡ Comptes Rendus, cxv. (1892) pp. 447–50, 475–8.

§ SB. K. Akad. Wiss. Wien, ci. (1892) pp. 657–705.

side of the organ, or of buds or shoots on the upper side; *hypotrophy*, when the reverse is the case; *amphitrophy*, when the growth is greatest on the shoots and buds on the sides of the mother-shoot. This is a contrivance for obtaining greater light by the leaves of very leafy trees, or of shrubs growing in the shade.

Dissemination of Plants by Buffaloes.*—Mr. E. L. Berthoud calls attention to the facility with which seeds, and even roots, of plants may have been carried from one part of North America to another in the hairy "pads" on the front of the buffalo during its annual migrations. He attributes to this, and not to the survival of an Arctic flora, the occurrence of many plants, such as species of *Cactus*, in the vicinity of Lake Winnipeg.

Dissemination of the Seeds of Oxalis stricta.†—Mr. E. Walker describes the mechanism by which the seeds of this plant are violently thrown out of the capsule when ripe, frequently to a distance of three feet. The erect capsule becomes flaccid on maturity, and the active agent in the propulsion is the outer coat of the seed itself, which consists of a translucent, shining, membranous envelope stretched tightly over the seed. When it bursts, it suddenly and elastically turns inside out, and projects the seed by doubling back against the axis of the capsule.

Physiology and Biology of Seeds.‡—According to Prof. A. Tschirch, the main purpose of the hard sclereid-layer of the testa of seeds is a protective one, while that of the mucilaginous epiderm of certain seeds is to fix them in the soil while germinating. The testa of all seeds has, in addition, in the young state, a layer of parenchymatous cells, which, in almost all cases, disappears on maturity. This layer is a transitory receptacle for food-materials. Cell-nuclei are present in all such receptacles, whether in the endosperm or the perisperm. There is always a means of conduction of the reserve-materials from the endosperm or perisperm to the embryo, varying according to the structure of the seed. When seeds of Dicotyledons germinate on the surface of the soil, the aleurone is dissolved, and its place is taken by chromatophores, which divide actively. In *Lupinus* chlorophyll is stored up in large quantities in the cotyledons even of unripe seeds; this disappears almost entirely when the seed is ripe, and is again formed during germination.

Parasitism of Cynomorium.§—Prof. G. Arcangeli has carried on a further series of experiments with regard to the parasitism of *Cynomorium coccineum*, especially on *Atriplex nummularia*. He failed to find any true intramatrical thallus corresponding to that of the Rafflesiaceæ and Balanophoraceæ. A good development of the *Cynomorium* was also obtained on a number of other plants belonging to a variety of natural orders.

Growth in Thickness of Trees.‖—In reply to Prof. R. Hartig, Herr L. Jost adduces further arguments in favour of his view as to the

* Bot. Gazette, xvii. (1892) pp. 321-6.

† Proc. Acad. Nat. Sci. Philadelphia, 1892, p. 288.

‡ Verhandl. Schweiz. Naturf. Gesell. Davos, lxxiii. (1892) pp. 260-6. Cf. this Journal, 1892, p. 233.

§ Bull. Soc. Bot. Ital., i. (1892) pp. 345-7. Cf. this Journal, 1892, p. 391.

‖ Bot. Ztg., l. (1892) pp. 489-95, 505-10. Cf. this Journal, 1892, p. 499.

mode of increase in thickness, and the formation of annual rings in dicotyledonous trees.

Influence of an Excessive Proportion of Carbonic Acid on the Growth of Roots.*—M. S. Jentys finds, from a series of experiments carried on chiefly on wheat and rye, that a condensation of carbon dioxide in the soil, even to the extent of from 4 to 12 per cent., has not such an injurious effect on the growth of roots as the experiments of Böhm seemed to indicate. The results, however, varied somewhat with different plants.

Assimilation of Carbon dioxide.†—By treating specimens of *Spirogyra* from which the starch had been entirely removed with substances which readily break up into simpler constituents, of which formic aldehyde is one, Herr T. Bokorny showed that these plants have the power of separating formic aldehyde from the nutrient solution, and then converting it into starch. This appears to furnish an argument in favour of the view that formic aldehyde is the substance first formed in the production of carbo-hydrates from the carbon dioxide of the atmosphere.

Mode of Absorption of free Nitrogen by the Leguminosæ.‡—Herr P. Kossowitsch describes in detail a series of experiments undertaken for the purpose of determining through what organs it is that the Leguminosæ have the power of absorbing free nitrogen from the atmosphere. The plant experimented on was *Pisum sativum*, and the *modus operandi* consisted in the substitution of hydrogen for nitrogen in the surrounding air. The result arrived at was that in all probability, the root is the organ where the free nitrogen passes into the combined condition.

Sigg. V. Alpe and A. Menozzi § confirm Frank's observations of the absorption of free nitrogen by plants, with the assistance of microbes, especially by the root-tubercles of Leguminosæ.

Exchange of Gases in the Root-tubercles of Leguminosæ.‖—Herr B. Frank describes the root-tubercles of the Leguminosæ (*Vicia Faba*) as being enclosed in several layers of suberized cells permeated by intercellular passages, which penetrate the cortical tissue of the tubercle (but not the meristematic tissue which completely surrounds the "bacteroid-tissue") as a perfectly closed envelope. The "bacteroid-tissue" is again itself permeated in all directions by intercellular spaces which are not in communication with those of the cortical layer, while these latter are so with the external air. The air in the "bacteroid tissue" must be derived from its own cells. When the tubercles are isolated they give off abundance of nitrogen gas after a time, especially the "albuminoid-tubercles"; ¶ but this appears to be the result of the commencement of decay, and not to be a normal phenomenon. The mode in which

* Anzeig. Akad. Wiss. Krakau, 1892, pp. 306–10. See Bot. Centralbl., lii. (1892) p. 93.

† Biol. Centralbl., xii. (1892) pp. 481–4.

‡ Bot. Ztg., l. (1892) pp. 697–702, 713–23, 729–38, 745–56, 771–4 (1 pl. and 6 figs.).

§ Bull. Notiz. Agrar. del Ministero d'Agricoltura, 1892, 32 pp. See Bot. Centralbl., li. (1892) p. 337.

‖ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 271–81.

¶ Cf. *supra*, p. 63.

the "bacteroid-tissue" gives up its nitrogenous constituents for the nourishment of the plant is still obscure.

(3) Irritability.

Causes of Sensitive Movements.* — M. L. Claudel regards the movements of certain organs in *Astericus maritimus*, *Carlina acanthifolia*, and *Anastatica hierochuntica* as hygroscopic. *Ceteris paribus*, the cells or fibres contract under the influence of desiccation in proportion to the thickness of their walls; and the longest fibres are those which contract least in their longest dimension.

Herr W. Pfeffer † considers that the movements of the stamens of the Cynareæ cannot be explained by imbibition or the elasticity of the cell-walls; they are rather due to the exosmose of soluble substances, or to the formation of substances of a smaller osmotic power in the active cells.

Nyctitropic, Gamotropic, and Carpotropic Movements.‡—Prof. A. Hansgirg gives the results of observations on a very large number of species with respect to the various kinds of movement observed in the stalks of buds, flowers, and fruits.

Nyctitropic movements—i. e. daily changes of position of the stalk, recurring during the whole period of flowering, which cause the bud or flower to bend downwards during the night or in rainy weather, and to stand erect, exposed to the sun, and visible to visiting insects during the daytime—were observed in many species belonging to many different orders. These movements are always most considerable during the early period of blossoming.

Far more common than these are other movements which occur only once, before or after the opening of the flower, or during the ripening of the fruit:—Gamotropic for the purpose of making the flower visible to insects from a distance, and facilitating pollination; and carpotropic for assisting the dissemination of the seeds. The very numerous examples of these movements are referred to six distinct types, represented by the genera *Oxalis*, *Primula*, *Veronica*, *Aloë*, *Fragaria*, and *Aquilegia*. Similar "hydrocarpic" movements occur in some aquatic plants. The phenomena in question are almost invariably the result of a combination of three factors, viz. of geotropic, heliotropic, and spontaneous curvatures, or of only two of these. The heliotropic and geotropic curvatures may be either positive or negative, and examples are given of all these various combinations.

In another communication, § Prof. Hansgirg distinguishes seven types of carpotropic curvature, viz. those of *Oxalis*, *Primula*, *Coronilla*, *Veronica*, *Aloë*, *Fragaria*, and *Aquilegia*.

The same author ‖ gives also lists of plants which display the following phenomena:—Periodic curvatures of flower-stalks; Periodic opening

* 'Observ. s. le mouvement de quelques plantes hygrométriques,' Marseille, 10 pp. and 1 pl. See Bonnier's Rev. Gén. de Bot., iv. (1892) p. 366.

† Abhandl. K. Sächs. Gesell. Wiss., xvi. (1891) pp. 325–37.

‡ Biol. Centralbl., xi. (1892) pp. 449–64. Cf. this Journal, 1891, p. 372.

§ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 485–94.

‖ Bot. Centralbl., lii. (1892) pp. 385–93.

and closing of flowers and inflorescences; Plants with ephemeral flowers; Plants with agamotropic flowers; Nyctitropic movements of leaves; Paraheliotropic movements of leaves; Irritability of leaves; Irritability of stamens; Xerochastic curvatures.

Propagation of Heliotropic Irritability.*—Herr W. Rothert has investigated this subject, with a view of deciding between the conflicting theories of Darwin and Wiesner. The objects specially observed were cotyledons of *Avena sativa* and *Phalaris canariensis*, which display remarkable heliotropic curvatures, seedlings of *Panicum sanguinale* and *miliaceum* and *Setaria viridis*, young plants of *Brassica Napus*, *Tropæolum minus*, &c.; in all cases the results were very similar.

The author finds the capacity for the propagation of heliotropic irritation to be widely distributed, though the intensity varies, and in many cases it is difficult to detect. In heliotropic seedlings it is very usual, though not universal, for the direct heliotropic sensibility—i. e. the sensitiveness of the protoplasm to illumination from one side—to vary in the different parts of an organ, and the greater degree of sensitiveness is limited to a comparatively small apical region; but direct heliotropic sensitiveness is never confined entirely to the apex. When this sensitiveness is not uniform, the variation is one of the factors in determining heliotropic curvature. A distinction must be drawn between direct and indirect heliotropic sensitiveness; the two together make up the entire heliotropic sensitiveness of an organ or part of an organ. Growth and heliotropic sensitiveness are entirely independent of one another; not only can growth take place without this sensitiveness, but there are organs, like the cotyledons of Paniceæ and the internodes of *Galium*, which are heliotropically sensitive after their growth has completely ceased. The power of heliotropic curvature of an organ is, *ceteris paribus*, a function of its intensity of growth and of its entire heliotropic sensitiveness; it disappears when either of these functions is reduced to zero; but there may be organs, like the hypocotyl of the Paniceæ, which curve heliotropically although they have no direct heliotropic sensitiveness.

Experiments on the removal of the head from growing seedlings showed that the head acts in two different ways:—in diminishing the intensity of growth, and in completely arresting heliotropic and geotropic sensitiveness. But both these results are only temporary; after a time the rapidity of growth and both kinds of sensitiveness again increase; and, after about twenty-four hours, the normal condition is again attained.

Artificial Production of Rhythm in Plants.†—Prof. F. Darwin and Miss D. F. M. Pertz find that, by the use of an intermittent klinostat, they can produce a rhythmic movement, i. e. a regular succession of nutations in different directions, in young growing plants (valerian, dandelion, canary-grass), due to the action of opposite and alternate stimuli of a geotropic and heliotropic character. The period of each rhythm was, in all cases, almost exactly half an hour. The rhythm continues after the conditions which have built it up have ceased to act;

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 374–90.
† Ann. Bot., vi. (1892) pp. 245–64 (6 figs.).

and, in this and other respects, the phenomena thus brought about artificially are compared to the nyctitropic movements of leaves. The authors consider that the results of these experiments confirm Charles Darwin's theory that all growth curvatures are developments or exaggerations of circumnutation.

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

Oil-splitting and Glycoside-splitting Ferments.*—A further investigation of the action of these two kinds of ferment in the plant leads Dr. W. Sigmund to the conclusion that no sharp line can be drawn between them, some of the ferments hitherto regarded as belonging to one of these two classes being able, in certain cases, to perform the function usually attributed to the other.

γ. General.

Relationship between Plants and Snails.†—Sig. L. Piccioli enumerates the various protective structures in plants to prevent destruction by snails. One of the most important of these is tannic acid, which occurs in large quantities in the leaves of many leguminous plants, in many plants belonging to the section Cynarocephalæ of Compositæ, in several genera of Rosaceæ, in several species of *Sambucus*, in *Humulus Lupulus*, *Cannabis sativa*, &c. The latex of many Compositæ, &c., is also protective, also the essential oil contained in the glands on the leaves of Labiatæ, of *Juglans regia*, *Eucalyptus globulus*, &c., and the raphides in the cells of *Arum maculatum*, species of *Cactus*, and many others. The author believes the Gastropoda to be endowed with a distinct sense of smell. Purely mechanical defences, such as a weft of hairs, spines, &c., occur in many plants, but are of less importance than the chemical.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Embryology of Angiopteris.‡—Prof. J. B. Farmer has studied the development of the embryo of *Angiopteris evecta*. The prothallium resembles the thallus of *Anthoceros* rather than the prothallium of most ferns, but is somewhat larger, and orbicular in shape. The antherid is formed from a superficial cell of the prothallium, which divides, by a wall parallel to the surface, into an outer shallow and an inner cubical cell. The former gives rise to the cover-cells by walls at right angles to the free surface, while the inner one originates the antherozoid mother-cells by successive bipartitions. The antherozoids are large, and are formed from the nucleus of the mother-cell. The antherids are distributed irregularly on both surfaces of the prothallium; the archegones occur on the lower surface only.

The basal wall of the fertilized oosperm is formed, as in *Isoetes* and *Equisetum*, at right angles to the axis of the archegone; the further cell-

* SB. K. Akad. Wiss. Wien, ci. (1892) pp. 549–59. Cf. this Journal, 1891, p. 221.

† Bull. Soc. Bot. Ital., i. (1892) pp. 338–45. Cf. this Journal, 1891, p. 499.

‡ Ann. Bot., vi. (1892) pp. 265–70 (1 pl); and Proc. Roy. Soc., li. (1892) pp. 471–4.

division is irregular. The two anterior epibasal contents together give rise to the cotyledon; and the apex of the stem is formed, not as in the leptosporangiate ferns, from one octant only, but from both of the posterior epibasal octants; the foot originates from the posterior pair of hypobasal octants beneath the stem; the root is formed from an anterior hypobasal octant. The root-apex in the embryo contains a group of meristematic cells, instead of the single apical cell characteristic of leptosporangiate ferns. There is also no single apical cell from which all the later stem-tissue is derived.

When the embryo has reached a certain size it bursts through the prothallium, the root boring through below, while the cotyledon and stem grow through the upper surface. In this process *Angiopteris* is peculiar among those ferns whose embryogeny is known. The stipular structures characteristic of Marattiaceæ are absent from the first two leaves; the leaf-stalks are covered with hairs which contain a large quantity of tannin.

Algæ.

Vegetable Growths as Evidence of the Purity or Impurity of Water*—Mr. A. W. Bennett discusses the value of the presence of vegetable growths in running streams as evidence of the purity or impurity of the water. His conclusion is that, in by far the greater number of cases, green living aquatic plants, whether phanerogamic or cryptogamic, can have nothing but a favourable influence on the purity of the water by promoting its oxygenation. This is especially the case with the Cladophoraceæ and the Conjugatæ. An exception occurs in the case of certain blue-green Algæ or Protophyta, *Oscillaria*, *Anabæna*, *Rivularia*, &c., which contain no chlorophyll in the ordinary sense of the word, and, in their decay, give out noxious and fœtid gases, which render the water unfit for domestic purposes.

Production of Zoospores.†—According to Prof. G. Klebs, the two phenomena of general growth and of non-sexual propagation in Algæ are antagonistic to one another; the same cell cannot perform the two functions at the same time. The production of zoospores is promoted, not by any single condition, but by the concurrence of a number; and, under favourable conditions of light, temperature, moisture, and the chemical constitution of the medium, the production of zoospores may be brought about even in very young cells.

Growth of Cladophora and Chætomorpha.‡—Herr L. Kolderup Rosenvinge states that the so-called coalescence of growth which frequently takes place between a main filament and its branch in these algæ is not a true coalescence; it originates from a gradual increase in length of the portion of the wall beneath the angle of the branch, which is common to the main axis and the branch. A very similar phenomenon occurs in *Polysiphonia*. A secondary coalescence of parts originally distinct may, however, take place. The prolification of cells of *Clado-*

* St. Thom. Hosp. Reports, xx. (1892) pp. 51–8. Cf. this Journal, 1890, p. 489.

† Arch. Sci. Phys. et Nat., xxviii. (1892) pp. 376–9.

‡ Bot. Tidskr., xviii. (1892) pp. 29–58 (23 figs.). See Bot. Centralbl., li. (1892) p. 409.

phora and *Chætomorpha* is also described; it appears to be a mechanical contrivance for resisting traction.

Propagation of Prasiola.*—Prof. G. v. Lagerheim describes two modes of propagation in a new variety of *Prasiola mexicana*. In one mode certain cells become detached from the margin of the thallus, after the conversion of the intermediate membrane into mucilage, round themselves off, and directly reproduce the thallus. In the other mode the single layer of cells becomes divided by horizontal and vertical walls into one or two layers of four-celled sporanges. These four cells become free by the conversion into mucilage of the membrane of the mother-cell, and are motionless spores of irregular roundish, ovoid, rectangular, or triangular form.

The second mode of reproduction presents strong analogies with the formation of tetraspores, and the author regards it as an argument in favour of the alliance of *Prasiola* with the Bangiaceæ, which he considers as directly derived from the Chlorophyceæ. He has observed pyrenoids with distinct crystalloids in the vegetative cells of *Prasiola*.

Reproduction of Vaucheria.†—Prof. G. Klebs has investigated the various modes of sexual and non-sexual reproduction in *Vaucheria sessilis*. He finds that the zoospores themselves, or the germinating filament springing from the zoospores, may give rise either to zoospores again or to sexual organs, or they may remain sterile, the results varying according to the external conditions of nutriment, temperature, and light. Similar variable results were obtained from the culture of oosperms. As in *Hydrodictyon*, there is no regular alternation of generations. A powerful production of zoospores takes place when a vigorous tuft undergoes a change in its external conditions, whether from air into water or from running into stagnant water, or a great change in the amount of light. The conditions for the formation of the sexual organs are much more complicated than those for growth. A low temperature or a small amount of light will maintain a tuft in the sterile condition for an indefinite period.

The formation of the sexual organs was found to obey the same laws in *Vaucheria terrestris*, *hamata*, *geminata*, *uncinata*, and *aversa*; but the phenomena of non-sexual propagation differ in the different species. In *V. terrestris* and *aversa* there are no special organs for this mode; *V. geminata* and *uncinata* produce motionless spores. *V. clavata* appears to differ from *V. sessilis* only in its physiological phenomena; growing in rapidly running water, its sexual activity is greatly reduced, while the formation of zoospores is proportionately promoted.

Fungi.

Mastigochytrium, a new genus of Chytridiaceæ.‡ — Prof. G. v. Lagerheim describes under this name a new genus of Chytridiaceæ allied to *Rhizophidium*, with the following diagnosis:—Zoosporangia extramatricalia, sessilia, unicellularia, basi filamentis mycelicis radiciformibus ramosis, matrice immersis et pilis validis lateralibus instructa;

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 366–74 (1 pl.).

† Verhandl. Naturf. Gesell. Basel, x. p. 45. See Bot. Centralbl., li. (1892) p. 377.

‡ Hedwigia, xxxi. (1892) pp. 185–9 (1 pl.).

zoosporæ (non visæ) per ostiola expulsæ; sporangia perdurantia? The only species, *M. Saccardiæ*, is parasitic on *Saccardia Durantæ*, itself a parasitic fungus from Ecuador.

Mycele of Peronospora.*—Dr. P. Voglino has determined by experiment that the mycele of the *Peronospora* of the vine may pass from the autumn leaves into those of the young buds, where it remains without further development through the winter, and may spread, in the next spring, to the leaves and inflorescence.

Fungus-parasites on Mushrooms.†—According to MM. J. Costantin and L. Dufour, mushroom-beds are liable to two diseases caused by the attacks of parasitic fungi, and known as "môle" and "chancre." The former causes sponginess of the tissues, and is produced by a *Mycogone* allied to *M. cervina*, which is the chlamydosporous form of a *Hypomyces* (Ascomycetes). It has also a sclerodermic form. The fungus which causes chancre presents the appearance of a *Verticillium*, but is simply the conidiferous form of the same or of a closely allied species. Instructions are given for obviating or curing the diseases.

M. J. Costantin ‡ further describes three other parasitic diseases which attack mushroom-spawn, known as "vert de gris," "plâtre," and "chanci." The first and second of these are produced by fungi belonging to the Mucedineæ, both types of new genera; that which causes "vert de gris" he describes under the name *Myceliophthora lutea*, the fungus which produces "plâtre" is named *Verticilliopsis infestans*. The fungus to which "chanci" is due has a peculiar odour, but its organs of reproduction have not been observed. The spread of these parasites is greatly assisted by certain insects which infest the mushroom-beds, especially *Sciara ingenua*.

Commenting on these communications, M. E. Prillieux § states that the disease known as "molle" or "môle" is due to the parasitism of a fungus which often produces at the same time fructifications of two different kinds, characteristic of the genera *Mycogone* and *Verticillium*; the *Mycogone* bears a very close resemblance to *M. rosea*.

Fungus-parasites of Apples and Pears.‖—Dr. P. A. Dangeard describes in detail the various diseases to which apple and pear trees are liable. The following are due to the attacks of parasitic fungi:—(1) Diseases of the stem and branches:—"le chancre cancéreux" is always found to be accompanied by *Nectria ditissima*, which is doubtless the cause of the disease; "le chancre noduleux" is caused by the attacks of a louse, *Schizoneura lanigera* var. *Pyri*, accompanied by the *Cladosporium* form of a pyrenomycetous fungus, *Cucurbitaria elongata* or *Diplodia mamillana*; ordinary cancer is produced by *Fusicladium pyrinum*; dry-rot of the wood by *Polyporus sulphureus*, or less often by *Ptychogaster aurantiacus* or *Hydnum Schiedermayri*. (2) Diseases of the leaves:—"fumagine" of the leaves is caused by *Fusicladium dendriticum*; rust by

* Giorn. coltivatore di Casalmonferrato, 1892, 7 pp. and 5 figs.

† Comptes Rendus, cxiv. (1892) pp. 498–501; Bull. Soc. Bot. France, xxxix. (1892) pp. 143–6, 148–9; and Rev. Gén. de Bot. (Bonnier) iv. (1892) pp. 401–6, 463–72, 549–57 (4 pls.).

‡ Comptes Rendus, cxiv. (1892) pp. 849–51.

§ Bull. Soc. Bot. France, xxxix. (1892) pp. 146–8 (1 fig.).

‖ Le Botaniste (Dangeard), iii. (1892) pp. 33–116 (10 pls. and 3 figs.).

several species of *Gymnosporangium*, chiefly *G. Sabinæ*, *juniperinum*, and *tremelloides*; oidium of the apple by *Erysiphe Tuckeri* and other ill-defined allied species. (3) Diseases of the fruit:—cancer is due to the attacks of *Fusicladium dendriticum*; dry-rot (pourriture) to *Monilia fructigena*. (4) Diseases of the root:—the disease known as "pourridié," or "blanc des racines" is produced by the rhizomorphous form of *Agaricus melleus*. Fermentation of the roots is a phenomenon due to asphyxia (want of oxygen) in living cells, containing sugar, causing the splitting up of this substance into alcohol and carbon dioxide, without the presence of any microbe. The insects which are destructive of apples and pears are also described, and remedies suggested for the various diseases.

Discriminating and Photographing Yeasts.*—Herr P. Lindner points out that stroke cultivations on wort-gelatin render it possible to distinguish between different yeast races, though their discrimination is easier effected by means of the giant colony. The ordinary view is that this shape of yeast-colonies is incapable of affording a diagnostic criterion, owing to their great similitude. The author, however, shows that this is only true for small colonies.

If yeast races be cultivated in flasks containing strong wort-gelatin until the colonies are very large, the shapes of these giant colonies are characteristic. The form and appearance of the colonies was fixed by photography, by which the differences among the colonies was permanently recorded. Zirconium light was used for illumination. The author also alludes to a "negro yeast," isolated from *pombé*. This might be called a "fission-yeast" as it does not sprout but divides into two halves by the pushing in of a partition. Each half, after division, grows up to the same size as the mother-cell. Spores are formed, and it ferments wort very well.

Influence of different Wine Yeasts on the Character of the Wine.†—Herr T. Kosutany mentions that at the present time the presence of the Phylloxera has been ascertained in 1717 parishes in Hungary, and that the attempt to repair the devastation produced by this insect by the introduction of American vines (plants resistant to the pest) has failed, owing to the disagreeable after-taste of wine made from these grapes. The author attempted to determine to what factors the character of a wine was due—whether they were primary, i.e. connected with the must, or secondary, i. e. set up during fermentation. Of course, if they were primary, they were inevitable, but if secondary, they might be preventible. Wine must made from Hungarian grapes, and containing 22·1 per cent. of sugar, was inoculated with various kinds of wine yeasts, and then fermented. The wine thus made showed notable differences not only in chemical composition—e.g. with the same must Méneser yeast produced 9·43, and Grünweltliner yeast 10·77 per cent. of alcohol—but also in bouquet, odour, and taste.

The author hopes that, by pursuing this line of investigation, a

* Wochenschr. f. Brauerei, 1891, p. 815. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 250–1.

† Landw. Versuchsstationen, 1892, p. 217. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 301–2.

better class of wine may eventually be produced from grapes of poor quality.

Fermentation of Bread.*—The fermentation of bread, says Boutroux, is principally an alcoholic fermentation of the sugar in the flour, in which the yeast plays a double part. It causes the formation of gas, which makes the bread swell up, and prevents the bacteria present in the flour from developing, whereby the souring of the dough, and decomposition of the gluten is obviated. As the gluten remains intact, every gas bladder in bread is incased in an elastic membrane, which on baking becomes still more delicate.

It is rare to find yeast in bread, and impossible to discover bacteria by microscopical means in fermenting dough; and the probable reason of this is that as dough is made with very little water, and as almost all of this is absorbed by the gluten and the starch, very little remains for the yeast cells.

Influence of Yeast on the Smell of Wine.†—Sig. G. Soncini has observed that if must of wine be fermented with yeasts obtained from different districts, the wine will have a bouquet resembling the wine of the country from which the yeast was derived.

Influence of Tartaric Acid on Brewer's Yeast.‡—Dr. E. C. Hansen, in some experiments made with brewer's yeast, which are practically a continuation of those made for the purpose of testing the value of Pasteur's pure yeast, has found that the cultivated varieties are completely repressed by the wild races. The experiments were made with yeast from a well-conducted brewery. The yeasts were cultivated in Pasteur's cane-sugar tartaric acid solution, and kept constantly at 9° C., or at the ordinary room temperature. In the course of the experiments it was found that a solution of 10 per cent. saccharose and 4 per cent. tartaric acid formed an excellent medium for showing whether there were any wild sorts in yeast lees. Three or four cultivations sufficed to give a decisive result.

Morphology and Biology of the Thrush Fungus (Oidium albicans).§—MM. G. Roux and G. Linossier obtained cultivations by means of Esmarch's and Koch's methods on gelatin, at 15°–20°. The colonies attained an ultimate diameter of 4–5 cm. They did not liquefy gelatin, were at first white, but later on became brownish. The source of the cultivation was aphthous patches in the mouth. The form of the fungus was predominantly yeast-like; that is, in most of the cultivations small oval bodies were the prevailing shapes, although in some media (melon) the filamentous were in the greatest abundance. No purely filamentous cultivation was obtained, all being mixed with yeast-like forms. The fungus was grown on 27 different media, details of

* Le Bulletin Med., 1891, p. 793. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 153–4.

† Nuova Rassegna di Viticoltura ed Enologia d. R. Scuola di Conegliano, 1891, No. 16. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 253.

‡ Zeitschr. f. d. ges. Brauwesen, xv. (1892) p. 2. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 146–8.

§ Arch. Méd. Exp. et Mat. Pathol., 1890, pp. 62–87, 222–52. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 733–6; xii. (1892) pp. 162–5.

which are given in the original. The vexed question of spore-formation is next discussed, and the authors reconcile contradictory observations by reporting that the various forms described are merely phases in the development of the chlamydospore. These bodies are developed at the end of a mycele, and are spheroidal cells with well-defined membrane, and, at first, finely granular contents. The contents soon aggregate to form a central body, surrounded by a number of highly refracting spherules. From the chlamydospores is developed the fungus, but the exact manner was not observed. The authors conclude their morphological examination by pointing out that the thrush fungus cannot be ranked with the family of Saccharomyces, and that the determination of its exact position is not at present possible.

The biological relations of *Oidium albicans* are considered under three divisions; the first dealing with conditions associated with change in the form of the fungus; the second with the influence of an acid or alkaline reaction of the medium; and the third with the nutrition of the fungus. In the course of these researches some interesting facts were brought to light, e.g. the simpler the molecular weight of the food-stuff supplied—at any rate, as far as carbohydrates are concerned—the more suitable was this as a pabulum; and the more complex the nutrient medium and its constituents, the more mixed did the vegetative forms of the fungus become. Cultivations constantly exhibited the tendency to retain their special characters for several generations. The most favourable reaction for the medium was a slightly alkaline one at starting. If too alkaline, growth was at first retarded, but afterwards accelerated owing to decomposition taking place in the medium. Slight acidity seemed to have no action on the growth, though too much acid stopped it. In any favourable conditions of growth the yeast form was predominant; when the conditions were inimical, then the filamentous form occurred; and, of course, there were many intermediate phases, called globoso-filamentous. The action of various gases and the effect of the absence of air on growth are exhaustively discussed.

One of the methods of observation pursued deserves a passing notice. It was the same as that used by Raulin for *Aspergillus niger*, the principle of which is to weigh the results of crops of a pure cultivation obtained under definite stringent conditions. In this way the value of different nutritive media was appreciated.

Pure Cultivations of Actinomycosis and its Transmissibility to Animals.*—Prof. M. Wolff and Dr. J. Israel have succeeded in making pure cultivations from a case of Actinomycosis hominis by sowing the granules on agar kept at 37° and devoid of air. Successful cultures on eggs, fresh or boiled for three to four minutes, were also obtained. Within and around the grains distributed over the agar surface are formed granulations, at first hyaline, but afterwards becoming opaque. On transferring the first cultivations to a fresh agar surface in three to five days numerous little granulations, resembling dewdrops, not larger than a pin's head, make their appearance. These usually remain separate, but may become confluent. Though the microbe is undoubtedly

* Virchow's Archiv, cxxvi. p. 11 (8 pls.). See Annales de Micrographie, iv. (1892) pp. 354–6.

an anaerobe, yet the presence of a small quantity of oxygen does not prevent its growth, for it will develope in puncture cultivations even though the access of air be not prevented—of course best at the lowest part of the puncture. It grows very well in alkaline bouillon.

The microscopical appearances presented by this microbe are very variable: short and long rods, simple, straight, branching or wavy filaments, cocci and felt-like masses, especially from the egg cultures, are to be seen.

The cocci are sometimes found free, but more frequently within the rods or filaments. The authors refrain from expressing a definite opinion as to their exact nature, but do not regard them as spores or degeneration conditions. They stain well by Gram's method.

In none of the cultivations were club-shaped elements met with, but by injecting these cultivations into animals, tumours containing club-shaped bodies were produced.

Twenty-two animals were inoculated with the agar cultivations, and in all, except one (a sheep), Actinomyces tumours were developed. Most of the inoculations were injections into the peritoneal sac. Pure cultivations were made from the tumours in the infected animals.

The authors consider that this micro-organism should be placed among the Mucedineæ, although its pleomorphism is obviously very marked.

Alternation of Generations in the Uredineæ.*—Herr P. Dietel has established a new example of this phenomenon, identifying *Æcidium Bellidiastri*, parasitic on *Bellidiastrum Michelii*, as a stage in the development of a new species of *Puccinia*, *P. firma*, found on *Carex firma*.

Uredineæ parasitic on Berberis.†—Herr P. Magnus describes several new species of Uredineæ parasitic on various species of *Berberis*:—*Uropyxis Naumanniana* on *B. buxifolia*, from an island in the Magellan Straits, distinguished by the pedicel of the teleutospores being broader than the spores themselves; *Puccinia Meyeri-Alberti*, from Chile, in which the groups of teleutospores are surrounded by a tuft of paraphyses; *Æcidium Leveilleanum*, from Chile, characterized by the flask-shaped form of the cells of the peridium; *Puccinia neglecta*, on a *Berberis*-leaf of uncertain origin; *Uredo Stolpiana*, from Chile, in which the germ-pores of the uredospores are distributed in two rings.

Fungus-parasites of cultivated plants.—M. E. Prillieux'‡ describes a disease which attacks the leaves of the quince, causing them to turn brown and flaccid. It is caused by a *Monilia*, nearly allied to *M. Linhartiana*, parasitic on *Prunus Padus*, which is the conidial form of *Sclerotinia Padi*.

Dr. J. B. De Toni§ enumerates and describes the various parasitic fungi which attack the tobacco-plant. Of these, some are peculiar to the genus *Nicotiana*, viz.:—*Læstadia Marii*, *Phyllosticta Tabaci*, *P. cap-*

* Hedwigia, xxxi. (1892) pp. 215–7.
† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 319–26 (1 pl. and 1 fig.).
‡ Bull. Soc. Bot. France, xxxix. (1892) pp. 209–12 (1 fig.).
§ 'Le Malattie Crittogamiche della pianta del Tabacco,' Padova, 1892, 4 pp.

sulicola, *Ascochyta Nicotianæ*, and *Oidium Tabaci*; while others—*Macrosporium commune*, *Epicoccum purpurascens*, and *Peronospora Hyoscyami*—are found also on other plants.

Herr E. Rostrup * attributes a very prevalent disease of the beet, known as "heart-rot," to the attacks of *Sporidesmium putrefaciens*. He finds on the plants affected a pycnid-form, to which he gives the name *Phoma sphærosperma*, and identifies it as a stage of development of the same fungus. A new species—*Peronospora Cytisi*—is described, which causes great ravages in seedlings of the laburnum; and a leaf-disease of *Camellia japonica*, caused by *Pestalozzia Guepini*.

Herr P. Magnus † gives a fuller description of the structure and life-history of *Peronospora Cytisi*.

Herr P. Dietel ‡ contributes full descriptions of *Phragmidium deglubens* and *Ravenalia inornata*, both parasitic on leguminous trees.

Mycorhiza of the Fir.§—Herr G. Henschel finds the mycorhiza only on the roots of young unhealthy fir-trees in Upper Austria; by far the greater number of the trees, including all the more vigorous ones, are entirely free from it. He regards it as injurious rather than symbiotic.

New Genera of Fungi.‖—Among a collection of Fungi from Ecuador, Herr N. Patouillard and Prof. G. v. Lagerheim describe a new genus of Agaricineæ with a superior hymene, *Rimbachia*, with the following diagnosis:—Fungi homobasidiosporei, carnosi, erecti, pezizæformes; hymenium leve, nonnullis venis e centro radiantibus reticulatum, et paginam superiorem pilei sistens; pagina externa sterilis, cum stipite contigua; sporæ hyalinæ.

Mr. G. Massee ¶ describes a new genus *Dendrographium*, which is in reality a compound *Helminthosporium* or a *Podosporium* with the conids in chains; the conids are coloured and septate; also another new genus *Thwaitesiella*, separated from *Radulum*.

New Luminous Fungus.**—Under the name *Pleurotus lux*, M. P. Hariot describes a new species of luminous fungus from Tahiti, distinguished from other luminous species of the same genus by its smaller size, and by belonging to a different section, the "dimidiati." It is found especially in the rainy winter season, and emits at night a light similar to that of the glow-worm, and so bright that it is used by the native women to illuminate flowers worn for personal adornment. The property lasts for about twenty-four hours after the fungus has been gathered.

* Tidsskr. f. Landökonomi, 1891, 17 pp.; and Gartner-Tidende, 1892. See Bot. Centralbl., lii. (1892) p. 136.

† Hedwigia, xxxi. (1892) pp. 149–51 (1 pl.).

‡ Tom. cit., pp. 159–65 (1 pl.).

§ Vierteljahrsschr. f. Forstwesen, 1892. See Bot. Centralbl., li. (1892) p. 392.

‖ Bull. Soc. Myc. France, vii. (1891) pp. 158–84. See Bot. Centralbl., lii. (1892) p. 11.

¶ Grevillea, xxi. (1892) pp. 1-6.

** Journ. de Bot. (Morot) vi. (1892) pp. 411-2.

Mycetozoa.

Plasmodiophora Vitis and californica.*—MM. P. Viala and C. Sauvageau describe in further detail the diseases of the vine known as "brunissure" and the Californian disease caused respectively by *Plasmodiophora Vitis* and *californica*. The latter is exceedingly destructive to both the wild and the cultivated vines in California, but is at present unknown in Europe. The relationship of these organisms to allied species is discussed in detail.

Protophyta.

α. Schizophyceæ.

Biology of Diatoms.†—L'Abbé Count F. Castracane describes a form of moist chamber or live-box, which he has found peculiarly well adapted for following out the life-history of individual diatoms. His observations under these conditions confirm him in the view that diatoms during the early stages of their existence remain fixed to one spot; and that the usual mode of their propagation is by spores or gonids.

In another paper‡ the same author reviews the opinions of the various authorities, and the arguments in favour of the existence of a mode of propagation by means of spores. He further states his conviction that, even in this embryonic stage, diatoms are enclosed in a more or less silicified envelope. The remains of these envelopes are sometimes to be found in the form of minute siliceous agglomerations within the parent frustule. No trace remains of the sporangial sac within which these embryonic forms were enclosed.

Species of Diatoms.§—Dr. A. M. Edwards doubts the existence of true species, or even genera, among the Diatomaceæ. At all events, he claims to have established that all the various species of *Schizonema* and *Homœocladia* are but forms of two species, while both these genera must be united with *Nitzschia*. Again, there are no good characters to distinguish *Schizonema* from *Navicula;* and the twenty-four species of *Micromega* can all be grouped under *Navicula fœtida*. Dr. Edwards's arguments are based on the fact that he finds specimens of the alleged different species or genera "in the same tube."

Schmidt's Atlas der Diatomeenkunde.—The last part published of this magnificent work (Heft 45) consists of 4 pls., 177–180; it is almost entirely occupied with species and forms of *Melosira*, fossil and recent, also a few of *Skeletonema* and *Trochosira*.

β. Schizomycetes.

Influence of Light on Bacteria.‖—Prof. H. Buchner, who recently showed the germicidal influence of light on bacteria suspended in water, has now demonstrated its fatal action on cultivations of bacteria on solid media. Alkaline meat-pepton-agar is liquefied by boiling, and

* Journ. de Bot. (Morot) vi. (1892) pp. 355–63, 378–88 (1 pl.). Cf. this Journal, 1892, p. 836.

† La Nuova Notarisia, iii. (1892) pp 146–51. Cf. this Journal, 1892, p. 655.

‡ Mem. Pontif. Accad. Nuovi Lincei, 1892, 31 pp.

§ Amer. Mon. Micr. Journ., xiii. (1892) pp. 212–6.

‖ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 217–9 (1 fig.).

then, having been cooled down to 40°, is inoculated with some kind of bacterium (*B. typhosus*, *B. coli comm.*, *B. pyocyaneus*, *B. choleræ*, &c.). The bacteria are to be regularly disseminated throughout the media, and then the agar is poured into a flat glass vessel. When cold and set, some device—e. g. a cross or letters of black paper—is fixed on the under surface of the capsule. The capsule is turned upside down, and the under surface of the agar plate exposed for 1–1½ hours to direct, or 5 hours to diffuse sunlight. The plate is then placed in a dark place, and in 24 hours the device appears from the development of the colonies, the rest of the plate being a blank. An illustration taken from a photograph of an agar plate sown with typhoid bacteria shows the result of the action of light extremely well.

Effect of Chloroform on Bacteria.*—M. Kirchner obtained the following results from his experiments with chloroform on bacteria :—

(1) Chloroform possesses no inconsiderable power over a large number of bacteria, but not over the spores of most of them. Of the pathogenic bacteria, anthrax, cholera, and typhoid bacilli, and *St. pyogenes aureus* were quickly devitalized, while the spores of tetanus and anthrax were unaffected even after prolonged action.

(2) Chloroform has no inhibitory action on spore development; for at a suitable temperature, and in the presence of chloroform, the spores become bacteria, and then the action of chloroform takes effect.

(3) Chloroform is no disinfectant in the broader sense of the word, but it possesses a certain antiseptic value which renders it suitable for preserving albuminous substances, as it represses fermentation and putrefaction.

(4) To be efficient, chloroform must be used not only in the undissolved condition, but in saturated solution, care being taken to prevent evaporation.

Soluble Pigments produced by Bacteria.†—M. L. Viron has succeeded in isolating some soluble pigments produced by bacteria, and in cultivating the micro-organisms which made them.

From an orange-flower water was obtained, by evaporation, a substance consisting of greenish granules, of rodlets and yellowish scales. This organic residue was composed of three different pigments, imparting to solutions violet, green, and yellow colours. As these pigments were not developed in sterilized water, they must have been due to the presence of living organisms, and by means of plate cultivations on different media some chromogenic cultures were isolated. The pigment was produced only on solid media. One of these organisms is regarded as a variety of *M. cyaneus* Schröter; another is called *Bacillus aurantii*, largish rodlets grouped in pairs; and a third *B. fluorescens liquefaciens*. Injection of the coloured fluid produced by this last showed pathogenic properties, but with the two first it was not so. After being bred through a few generations, these micro-organisms lost the power of producing pigment, but it came back again if they were cultivated in stronger nutrient media.

* Zeitschr. f. Hygiene, viii. (1890) pp. 465–88. See Bot. Centralbl., l. (1892) pp. 359–60.

† Comptes Rendus, cxiv. (1892) pp. 179–181.

New Phosphorescent Bacterium.*—Herr C. Eijkmann describes a new phosphorescent bacterium, *Photobacterium javanense*, common on marine fish in the Dutch East Indies. It is most nearly allied to *P. Pfluegeri*, but differs from that species, *P. phosphorescens*, and *P. pathogenicum* in its greater motility and in its adaptation to a higher temperature. It does not liquefy gelatin, and has a bluish-green light with much white.

"Mal Nero" of the Vine.†—Dr. B. Pasquale has studied, especially in Sicily, the phenomena and causes of this destructive disease, which manifests itself in the form of black spots and streaks on the leaves. He believes it to be due to the attacks of a parasitic Schizomycete which developes chiefly in the tissues rich in protoplasm and in other plastic materials, such as the cambium, the medullary rays, the cortical parenchyme, and the soft bast of the axile organs.

Micrococcus tetragenus concentricus.‡—Prof. S. L. Schenk gives this name to a new micro-organism which occurred in the fæces of a patient suffering from stomachic catarrh. It has numerous characteristics, the most notable being the formation of concentric rings in gelatin culture.

Micrococcus pneumoniæ crouposæ.§—Dr. G. M. Sternberg calls attention to the fact that he was the first to describe the micro-organism so intimately associated with pneumonia, and which has received the different aliases of *Microbe septicémique de la salive* (Pasteur), *Coccus lancéolé* (Talamon), *M. Pasteuri* (Sternberg), *Pneumococcus* (Fraenkel), *Diplococcus pneumoniæ* (Weichselbaum), *B. salivarius septicus* (Flügge), *St. lanceolatus Pasteuri* (Gamaleia). The author's paper was entitled "A fatal form of septicæmia in the rabbit, produced by the subcutaneous injection of human saliva." But, besides substantiating his claim to priority, the author has the further object of suggesting a suitable name for the micro-organism which, as he points out, is not a diplococcus but rather a streptococcus.

Micrococcus agilis citreus.‖—Dr. K. Menge adds another flagellated coccus to the list. This bacterium was found on a gelatin plate, and its suspected source of origin was a pea infusion, although it was also found in the air of the laboratory. It appears to be about the same size as *M. agilis*. The arrangement of the individual elements is variable and presents no specific order. In hanging drop-cultivations the movements were seen to be very lively, and the flagellum was easily stainable by Loeffler's method. The flagellum was found to be about six times as large as the diameter of the coccus, and was best demonstrated when 15 drops of 1 per cent. NaHO were added to 16 ccm. of Loeffler's mordant. The micro-organism grows well on agar and gelatin, and aerial colonies are of a yellow colour, but their shape does not appear to present anything specially characteristic. Cultivations were also made in bouillon,

* Geneesk. Tijdschr. Nederland.-Indie, xxxii. (1892) pp. 109–15. See Bot. Centralbl., lii. (1892) p. 10.

† Malpighia, vi. (1892) pp. 229–34.

‡ MT. Embryol. Inst. K. K. Univ. Wien, 1892, pp. 81–91 (3 figs.).

§ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 53–6.

‖ Tom. cit., pp. 49–52.

in milk, and on potato. The optimum temperature was about 20° C. The formation of pigment was found to depend on the influence of light; for, although there was no diminution in the energy of growth, yet when the cultivations were kept in the dark they remained quite white. No experiments were made on the formation of pigment with different kinds of artificial light, nor any examination of the chemical properties of the pigment.

Disease of the Nun (Liparis monacha).*— Herr C. von Tubeuf records some observations made in the Bavarian woodlands during 1890 and 1891 on diseases affecting the Nun (*Liparis monacha*). One of these, a kind of lethargy, eventually fatal, is caused and spread by bacteria. It is a malady of the digestive system, fostered by definite climatic conditions. The caterpillars ceased to eat, became flaccid, their head and body drooped, and they hung on by a few pairs of feet only. The skin becomes partially filled out with a brown oily fluid, from which the malady might be designated the fat disease. In this fluid all sorts of bacteria, which eventually destroy the caterpillar, are found. The sick nuns collect in thick masses at the tops of the pine trees, where they become torpid and die—a phenomenon known as the "topping of the nuns." At the same time many caterpillars may be seen in a lethargic state on the trunks. The blood and intestinal contents of sick caterpillars were examined, and especially that of the foregut, which was ejected during the irritative stage. When healthy, this was green and composed of fragments of leaves with some bacteria, but in the sickly caterpillar it became brown with masses of bacteria. From cultivations, a mobile bacterium (*Bact. monachæ*) 1 μ long and 0·5 μ broad was obtained: this usually was in pairs or chains. The colonies did not liquefy gelatin. In colour like mother-of-pearl or opal with yellowish centre, the colonies present a characteristic lobate appearance which becomes more marked with age. *Bac. monachæ* is strongly aerobic. Healthy nun caterpillars were infected by feeding them on leaves which had been sprinkled with water containing this bacterium, while the caterpillars of other butterflies were unaffected. Usually the disorder is very chronic, and when acute is the result of cold wet weather, when, owing to the caterpillars having little to eat, the Schizomycetes are enabled to multiply in the foregut rather than in the solid contents of the after-gut.

New Chemical Function of the Cholera Bacillus.†—M. J. Ferran has found that by cultivating the cholera vibrio in slightly alkaline bouillon containing lactose, paralactic acid is produced in quantity sufficient to impart to the medium a distinctly acid reaction, and if it be coloured with litmus the medium turns red. A cultivation made in slightly alkaline bouillon to which lactose has been added, and kept at 30° C. for five days, presents a scum composed of large bacilli, in the interior of which highly refracting bodies resembling spores can be seen; finally all the protoplasmic contents disappear, and these little bodies, which stain very well with methyl-violet, are set free.

* Forstlich-naturwiss. Zeitschr., i. (1892) pp. 34-47, 62-79 (4 pl.). See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 268-9.

† Comptes Rendus, cxv. (1892) pp. 391-2.

The same cholera bacillus sown in alkaline bouillon remains alive for quite three years, provided that provision be made for daily renewing the air by stuffing the neck of the cultivation apparatus with cotton-wool. Yet if, under exactly similar conditions, some lactose be added to the bouillon, the microbe soon perishes in consequence of the presence of the acid produced by itself.

The growth of the microbe is always rapid and luxuriant in plain bouillon, but if lactose be present it is far more so, the cultivation acquiring a surprising density in a few hours; but when the medium turns acid the growth is suspended and the organism dies.

The author concludes by pointing out that paralactic acid, so useful as a remedy for diarrhœa caused by *B. coli commune*, may be efficacious in the case of cholera-diarrhœa.

Influence of Wine on Development of Typhoid and Cholera Bacilli.* —Dr. A. Pick points out that when typhoid and cholera are rife it would be a good thing to dilute drinking-water with an equal volume of wine. This he deduces from the results of some five experiments on infected water diluted with white or red wine. The mixtures were left for twenty-four hours, and then cultivations made. It was found that even in half an hour there was a perceptible diminution in the number of germs, and in twenty-four hours they had all disappeared.

Action of Bacillus of Malignant Œdema on Carbohydrates and Lactic Acid.†—Herren R. Kerry and S. Fraenkel state that when lactic acid, in the form of its calcium salt, is dissolved in bouillon containing peptone and Kemmerich's meat extract, and the solution, placed in an atmosphere of hydrogen, is inoculated with the bacillus of malignant œdema, fermentation occurs. After remaining from 8 to 10 days, the solution contains propyl alcohol and formic and butyric acids, but no ethyl alcohol.

Bacterium which ferments Starch and produces Amyl Alcohol.‡— M. L. Perdrix has separated from Paris water a bacillus, *B. amylozymicus*, which ferments starch with production of amyl alcohol. It is separated by cultivation on potato, and finally on gelatin. The bacillus is 2–3 μ long and 0·5 μ thick; the rods are joined in pairs and chains, and in the absence of oxygen are, like *Vibrio butyricus*, motile. The rods are readily stained; the spores are set free on the dissolution of the walls of the mother-cell. This bacillus flourishes only in the absence of oxygen, but readily either in a vacuum or in hydrogen, nitrogen, or carbonic anhydride. The optimum temperature is 35°; it grows quite well at 20–25°; at 16–17° fermentation commences at the end of four days. Its maximum temperature is 42–43°. It will grow in all the usual cultivating media, ferments sugars and starch, but does not attack cellulose or calcium lactate, differing in this respect from *V. butyricus*.

Mixed Cultivations of Streptococci and Diphtheria Bacilli.§— Dr. M. von Schreider confirms the results of Roux and Yersin as to the

* Centralbl. f. Bakteriol. u. Parasitenk, xii. (1892) pp. 293–4.
† Chem. Monatsb., 1891, pp. 350–5. See Journ. Chem. Soc., 1892, Abstr., p. 91.
‡ Ann. Inst. Pasteur, 1891, No. 5. See Journ. Chem. Soc., 1892, Abstr., p. 90.
§ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 289.

increased toxicity of mixed cultivations of diphtheria bacilli and Streptococci, micro-organisms invariably associated in diphtheritic membrane. Whether the substance which is precipitable from its aqueous solution by means of alcohol is an albumose or not is left undetermined.

Streptococcus obtained from the Blood of a Scarlet Fever Patient.* —MM. d'Espine and Marignac obtained from the blood of a scarlet fever patient a pure cultivation of a Streptococcus which presented clear differences from *St. pyogenes* and from the short Streptococcus of Lingelsheim. The question whether this microbe has any ætiological significance for scarlet fever is left undecided, as inoculation experiments on human beings are prohibited.

Bacterium coli commune.†—MM. Lesage and Macaigne have been carrying on experiments relative to the virulence of intestinal bacteria. *B. coli commune* did not show that it was pathogenic to animals, although it had been derived from a man suffering from diarrhœa.

Diarrhœa, for example the simple diarrhœa of children, say the authors, makes *B. coli commune* virulent. In cases where no diarrhœa has existed *B. coli commune* does not migrate during the first twenty-four hours after death into the organs of the body, although it does so if there have been diarrhœa, ulceration of the intestine, or pulmonary disorder. Besides this harmless *B. coli commune*, which the authors consider a saprophyte, *B. coli septicum*, an organism of great virulence, and *B. coli pyogenes*, not quite so virulent, are found in the intestine of sick persons.

B. coli cholerigenes, isolated by Gilbert and Girod in several cases of cholera nostras, both in adults and children, is a very virulent organism, and preserves its power for seven months. The more severe the case the more frequent became the presence of this micro-organism, while in less severe cases several other bacteria accompanied it.

Differential Characters of Bacterium coli commune and Bacillus typhosus.‡—According to M. E. Tavel the following differences exist between *B. coli commune* and *B. typhosus*:—(1) The former only exhibits molecular movements, the latter shows lively spontaneous movements. (2) On grape-sugar-agar the first forms gas, the latter none. (3) The former imparts a slight red colour to bouillon and clouds it strongly, with the latter it remains pale yellow and never shows a scum. (4) On potatoes the former forms a thick grey-yellow culture, the potato becoming greyish-brown; the typhoid bacillus produces scarcely visible colonies, and the colour of the potato remains unchanged. (5) The typhoid bacillus has flagella, *B. coli commune* none. The author is of opinion that the careful and judicious use of these criteria will enable a differential diagnosis between these two micro-organisms to be made.

* La Semaine Méd., 1892, No. 29. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 157.

† La Semaine Méd., 1892, p. 40. See Centralbl. f. Bakteriol. u. Parasitenk , xii. (1892) p. 257

‡ La Semaine Méd., 1892, p. 52. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 256–7.

Relations of, and Differences between Bacillus coli communis and Bacillus typhosus.*—By comparing the appearances of the organisms obtained from the fæces and from the blood of typhoid patients MM. Rodet and Roux have endeavoured to establish a direct relation between *B. coli communis* and *B. typhosus.* The blood, obtained by puncturing the spleen, gave *B. typhosus*; and the fæcal matter, inoculated in bouillon and kept at 44°·5, gave pure cultivations of *B. coli communis.* Similar results were obtained from cultivations on gelatin plates. These results afford support to the hypothesis that the typhoid organism is only a modification of *B. coli communis*, and the authors strive to show that the differences between the two microbes are not sufficient to create two distinct species. Thus, cultivated in gelatin, typhoid bacilli are not constant in character and they frequently resemble cultures of *B. coli communis.* In bouillon the latter grows more vigorously and forms a slight scum, but similar scum is sometimes formed by *B. typhosus*, and when kept at 44° the appearances of both are quite similar. Yet *B. coli communis* can bear a higher temperature than *B. typhosus* (46°·5 and 45°). Potato cultivations also present differences, chiefly in colour.

The microscopical characters of these organisms are chiefly that *B. coli communis* is short, the cells being of equal length. It is less mobile and stains more easily than the other. The bacillus of Eberth is of unequal lengths and more slender. Anything which weakens the vitality of *B. coli communis* (heat, antiseptics) tends to make it resemble *B. typhosus.* Hence the authors conclude that the latter organism is a degenerate variety of *B. coli communis;* yet they do not assert that typhoid fever is produced by *B. coli communis*, although it may acquire typhogenic properties.

Against this view, MM. Chantemesse and Widal point out that *B. coli communis* can be found not only in typhoid but in other fever patients, and that the Eberth-Gaffky bacillus retains its typical characters in the organs of typhoid patients even though it remains encapsuled for fifteen months. If *B. coli communis* become pathogenic (peritonitis, suppuration, choleraic diarrhœa), its characters are unaltered and it never resembles *B. typhosus.* Nor do the symptoms and lesions occasioned by *B. coli communis* ever resemble those of typhoid fever. An important distinction between the two is that *B. coli communis* ferments sugar and *B. typhosus* never does. Yet this distinction has been denied, on the authority of Dubief, who finds that *B. typhosus* can ferment glucose, although much less energetically.

Pathogenic Bacterium in Frogs' Livers.†—Dr. F. Fischel finds that the livers of healthy frogs often contain bacteria. Plate cultivations were made from the mashed up livers, and in about 36 hours numerous colonies, about the size of pins' heads, were observed lying deep in the gelatin. The organism was also grown on agar, potato, blood-serum, and in bouillon. The gelatin was not liquefied. The micro-organism as obtained from hanging drop cultivations is a rodlet of

* Journ. des Connaissances Méd., 1890; Séance de l'Acad. de Méd., 13th Oct., 1891. See Ann. de Microgr. iv. (1892) pp. 361–3.

† Fortschr. d. Med., ix. p. 340. See Annal. de Microgr., iv. (1892) pp. 357–8.

1/2–1 μ long, and 1/4–1/2 μ broad. It is extremely mobile, and is easily stained with phenol-fuchsin and by Gram's method.

Mice inoculated with bouillon cultivations die in 36–48 hours after subcutaneous injection, and 18–24 after intra-peritoneal injection. Blood taken from these infected mice kills fresh mice in 36 hours. After 6 days the animals no longer die, although they sicken for a time. At this period the cultivations no longer show bacilli in chains, but in discoid masses, and apparently surrounded by a capsule. Very similar results were obtained from infecting rabbits. By cultivation in artificial media this microbe soon lost its virulence. It was not found in the water in which the frogs were kept.

Streptococcus longus.*—Dr. Behring finds that pathogenic Streptococci are divisible into two species :—A. *Streptococcus brevis;* B. *Streptococcus longus.* The latter may be further differentiated into several sub-species, e. g.—1. Cocci which cloud bouillon; 2. Cocci which do not cloud bouillon. Group 2 is, again, subdivisible into three varieties : —*a.* Cocci which form a soft mucoid sediment; *b.* Cocci which form a scum or crumbling sediment; *c.* Cocci which "ball" together, and tend to stick to the sides of the tube.

The most important point about these differences seems to be that the more the cultivations show this balling the more virulent they are, especially for white mice; and the author's researches were principally directed to discovering if the variations of these pathogenic cocci were mere sports of the same species, or whether the cocci found in different diseases were specifically constant.

The experiments, which were made in collaboration with other observers, tended to show that there was no specific difference, the particular form of disease being due to the condition of the natural medium (the patient). The observations, however, resulted in what the author considers a very important fact. It was found that an animal which had been rendered immune to the Streptococcus most virulent to it, has acquired immunity to all other Streptococci.

Phagocytes and Muscular Phagocytosis.†—The tail of a tadpole has been sufficient to stir up a scientific strife, not only about the powers, but even touching the actuality of the phagocyte. The almost universal belief that the white corpuscles of the blood exercised phagocytic functions has been rudely shaken. It had become generally understood that when a phagocyte was spoken of, a wandering mesodermic cell, an amœboid corpuscle of the lymph or of the blood, was almost always meant, although some fixed cells (of doubtful origin) possessed the power of catching, incorporating, and assimilating other cells. It would now appear that this is a mistake. The inventor of phagocytosis disdains any such notion. It is wrong to mix up a phagocyte and a leucocyte. "Il ne m'est jamais arrivé de les identifier avec des leucocytes," says M. E. Metschnikoff. For the general belief there is much excuse, considering there are explicit statements to the effect that phagocyte and leucocyte are synonymous expressions.

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 192-6.

† Annal. Inst. Pasteur, vi. 1892. See Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 582-4; xii. (1892) pp. 81-7.

The disappearance of the tadpole's tail has been described by M. E. Metschnikoff as being the result of a "muscular phagocytosis," a condition in which the whole of the muscle becomes converted into a mass of phagocytes, inclosing within them the striated substance of the muscles; these phagocytes are therefore developed from the muscle itself, and are not connected with leucocytes at all. In the formation of the muscular phagocyte the sarcoplasm and nuclei of the fibril participate, the myoplasm—i. e. the sarcolytes—being destroyed within them. Eventually these phagocytes appear in the abdominal cavity as lymph-leucocytes.

According to Dr. A. Looss, the degeneration is carried out through the agency of the lymph; according to M. E. Metschnikoff, it is self-begotten of the muscle-fibril.

In his reply, Prof. E. Metschnikoff* makes his position quite clear as to the cause of the atrophy of the tadpole's tail. It is the result of phagocytosis, an active process, and not, as Dr. Looss considers, due to absorption of the muscular tissue by the fluids of the body. Moreover, the two observers seem to be at variance as to their facts, for according to Metschnikoff, the striated muscular substance only disappears, while Looss contends that the whole fibril is absorbed. It is, therefore, no wonder that considerable scientific recrimination takes place, and though Prof. E. Metschnikoff's facts seem indubitable—for, as he says, well-known savants such as Malassez have admitted their correctness—yet his adversary is clearly his superior in polemical writing—e. g. it is not argument to say that certain illustrations show no nuclei, and yet they were undoubtedly present—that is merely another way of saying that a scientific opponent has, well, suppressed certain facts, and is not fit for ordinary society.

Spleen and Immunization.†—Dr. A. A. Kanthack, after noting the results of Tizzoni and Cattani, who showed that it is impossible under certain circumstances to render rabbits from which the spleen had been removed immune to tetanus, remarks that tetanus is, *par excellence*, an intoxication disease, and that it would be illogical to draw general inferences therefrom. It is important, therefore, to ascertain the behaviour of animals without spleens towards other microbes, the virulence of which depends in a less degree on intoxication. The infection of *Bacillus pyocyaneus* was chosen, and its action observed (1) on rabbits from which the spleen had been removed, and then treated in company with other fresh animals by various methods of immunization; (2) on rabbits which had been rendered immune, and then deprived of their spleen. The experiments showed that in *Pyocyaneus* infection, absence of the spleen exerted no influence whatever.

Bacteriological Examination of Water.‡—One of the principal objects of Herr Max Dahmen's investigation was to ascertain the optimum amount of sodium carbonate which should be added to meat-pepton-gelatin in order to bring about the development of the greatest number

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 294–6.

† Tom. cit., pp. 227–9.

‡ Chemiker-Zeitung, xvi. (1892) No. 49. See Centralbl f. Bakteriol. u. Parasitenk., xii. (1892) pp. 302–3.

of germs. In dealing with Rhine water this was found to be 0·15 per cent. It is also pointed out that bacteriological examination should be directed less towards the quantity of germs in a given bulk of water than to their quality, for it is obviously very important to detect the presence of pathogenic and putrefactive bacteria even when a chemical analysis may have pronounced it fit for use.

Distribution of Water-bacteria in large Water Basins.*—Dr. J. Karlinski records some observations made on the bacteria of Lake Borke in Bosnia. The physical characters of the lake, its average temperature, the composition of the water, are first described, after which some new bacteria peculiar to this water are dealt with. A large number of observations were made, and the result of these went to show that there is a connection between the depth of the water and the number and character of the bacteria at the different levels, and also at different distances from the bank.

Pyosalpinx and Bacteria.†—Dr. Witte states that in two out of four cases of pyosalpinx operated on by Dr. A. Martin *Bacillus lanceolatus* Fraenkel was found, and in the third case bacilli resembling those of symptomatic anthrax. However, when the latter were inoculated in white mice, the animals died with extensive œdema of the subcutaneous tissue, and the result was due to the bacilli of malignant œdema. In case 4 the contemporaneous presence of staphylococci and of gonococci in the pus of pyosalpinx is an important discovery, as their coexistence has been denied.

Changes in the Microbicidal Power of the Blood during and after the Infection of the Organism.‡—It is well known, say Dr. A. von Székely and Dr. A. Szana, that the number of microbes present in extra-vascular blood or blood serum is at first diminished, but some hours after inoculation an increase is observed, while there are cases in which defibrinated blood or blood serum remains sterile in spite of the large number of microbes with which it was infected. An analogous diminution is found to occur even when bouillon is used instead of blood or serum. The germicidal action has, therefore, been attributed to the physical property of the medium—namely, its density. While admitting the probability that some of the germicidal power of blood may be due to its density, the authors refuse to ascribe the whole of this power to a mere concentration of the fluid. At present, the chief interest in this question is whether the circulating, living blood possesses a similar germicidal power to that of extra-vascular blood. The direct experimental proof of this is, from the nature of things, difficult, and the authors attempt to solve this question indirectly. The position they take up at starting is that the microbicidal power is a property of living blood, and that if there be any connection between this property and the course of the disease, then it must alter directly the germs have firm hold of the organism, and also when the organism has victoriously withstood the infection.

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 220–3.

† Centralbl. f. Gyn., 1892, No. 27. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 266.

‡ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 61–74, 139–42.

After alluding to the experiments of Charrin and Roger, Lubarsch and Rovighi, the results of which are contradictory the one of the other, the authors mention the method they adopted. The principal experiments were made with *Bacillus anthracis*, cholera bacillus, and *St. pyogenes aureus*, and a few with hydrophobia. The blood was obtained from the carotid, and while strict aseptic precautions were adopted during the operation, the use of antiseptics was carefully avoided, in order that the blood might not be contaminated with a foreign element, and thus endanger the results of the experiment. The blood was received into sterilized glass vessels by inserting the artery into the neck of the flask. The blood was then defibrinated by means of glass beads, and removed to another vessel, in order that the clot might not interfere with the equal distribution of the microbes. The blood, placed in little flasks, was caused to set obliquely, and then the flasks, having been set upright, were kept at a temperature of approximately 4° C. The blood was infected with agar cultivations rubbed up into an emulsion either with 0·75 per cent. salt solution or with bouillon. Upon the uniform distribution of the germs in the serum or defibrinated blood great stress is laid. Blood inoculated in the foregoing manner was tested from time to time by removing a loopful, and then, having carefully mixed it with liquefied gelatin, it was spread out on plates, and these kept at a temperature of 22°–24° C.

In the first set of experiments the microbicidal power of blood taken from an animal with anthrax was examined, and it was found that blood serum or defibrinated blood of rabbits suffering from anthrax can destroy anthrax bacilli, even though these are demonstrable in the blood; but when the disease has acquired a firm hold this power is lost.

The second set relates to experiments with *St. pyogenes aureus*, and these showed that the blood of rabbits infected with *St. pyogenes aureus* possesses up to a few hours before the death of the animal its germicidal power, and that this property is first lowered during the act of dying, and is altered in such a way that the microbes in the blood not only do not disappear, but actually increase after the lapse of 5–7 hours.

In the third set the blood was taken during and after the infection of the animal with cholera bacilli. It would seem that defibrinated blood taken from an animal the blood-stream of which is crowded with bacilli, affords a medium for the multiplication of micro-organisms, but that 24 hours after an intravenous injection, and therefore when all the bacilli had disappeared from the circulation, the germicidal power increased, and when the animal became hydræmic this microbicidal action was still more powerful.

In the next set it was found that the febrile state also increased the microbicidal power.

The last set of experiments was devoted to the connection between the quantity of the microbes and the amount of the microbicidal power, and these showed that the same quantity of blood was capable of destroying a definite number of microbes.

Fraenkel and Pfeiffer's Photomicrographic Atlas of Bacteria.*— This very useful and excellent atlas is now completed. In all, there

* Berlin, 1891–2. See Centralbl. f. Bakteriol. u. Parasitenk, xii. (1892) pp. 249–50.

have appeared 15 parts and 74 plates. The last few numbers deal chiefly with *Bacillus typhosus*, the microbes of pneumonia and suppuration, but numerous other organisms are represented, such as recurrens spirillum and some bacteria pathogenic to animals; at the conclusion are found fungi, such as *Actinomyces*, *Achorion Schönleinii*, and others.

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MICROSCOPY.

a. Instruments, Accessories, &c.*

(1.) Stands.

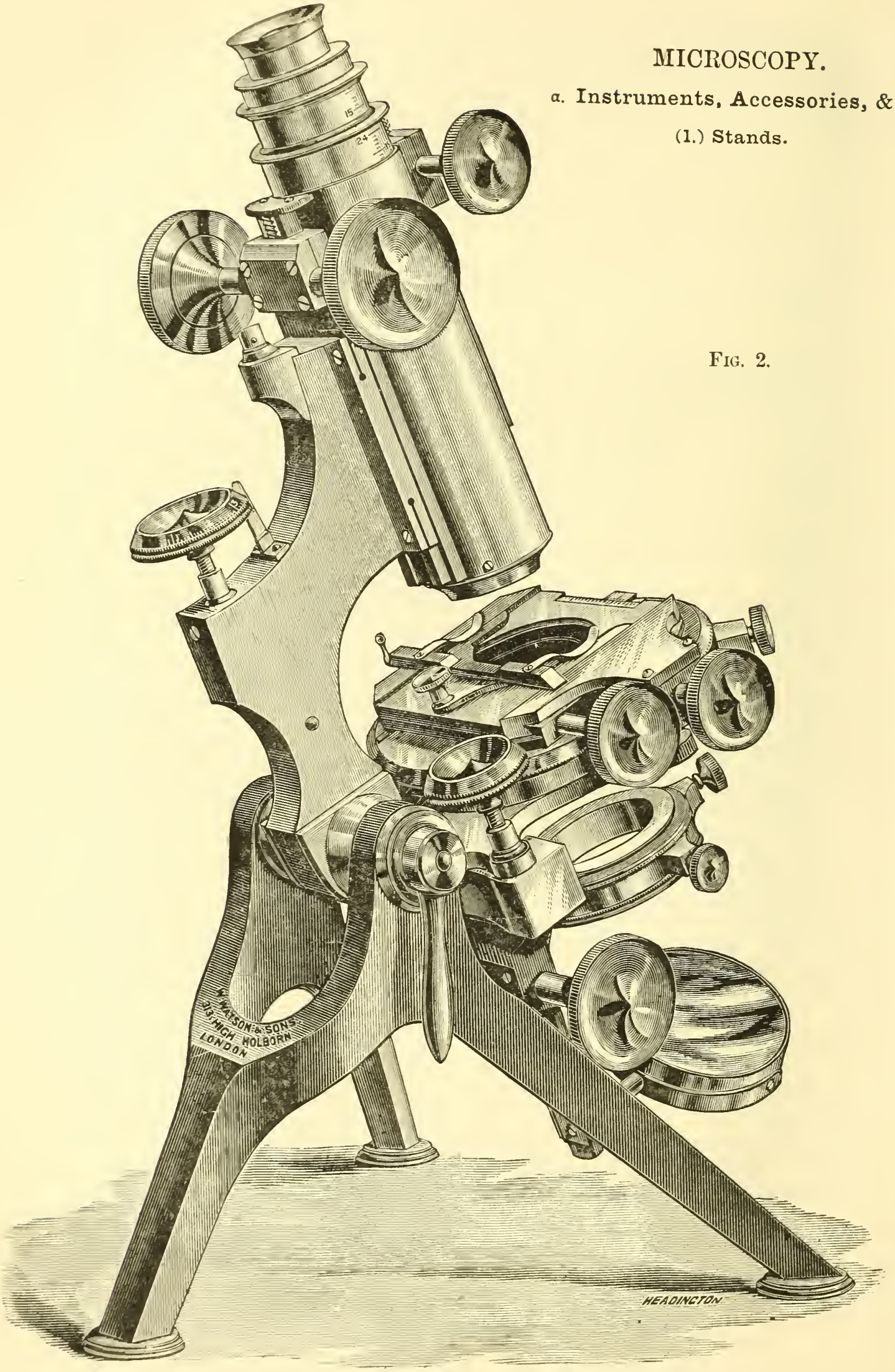
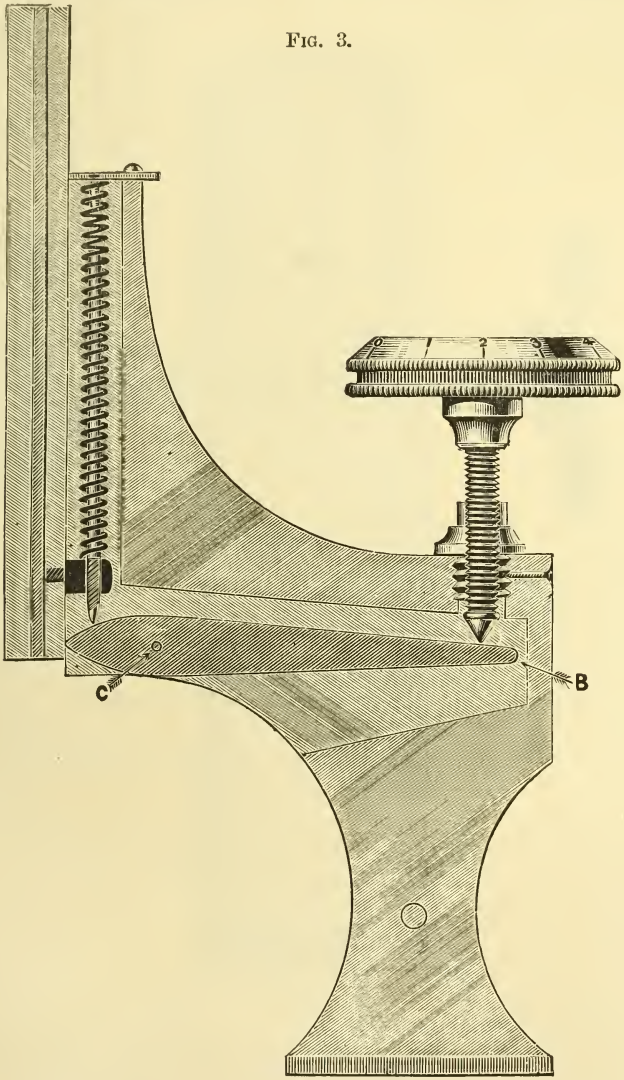


Fig. 2.

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

Messrs. W. Watson and Sons' No. 4 Van Heurck Microscope (B) (fig. 2).—Mounted on plain tripod foot, showing centering screws to stage. Height, when placed vertically and racked down, $13\frac{1}{8}$ in. The instrument is identical in all respects with the A and B forms, but is mounted on a different foot.

Fig. 3.

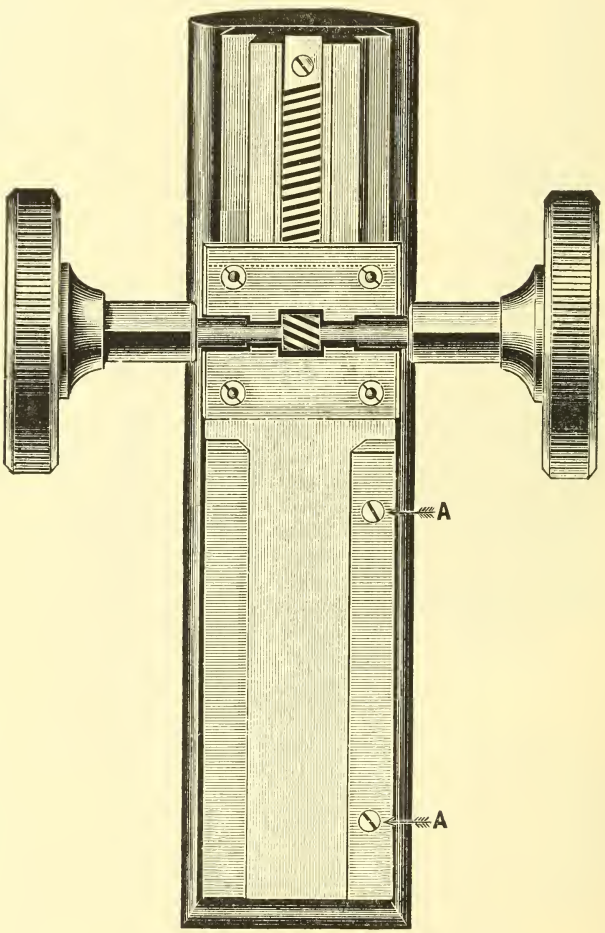


Messrs. W. Watson's Fine-Adjustment.—In calling attention to their system of fine-adjustment, Messrs. Watson write as follows:—"The entire body [of the instrument] is raised or lowered by means of

a milled head fixed to a screw having a hardened steel point, acting on a lever, in a perfect fitting dove-tail slide, about 2½ in. long. The principle of it is shown in the accompanying figure (fig. 3).

At first sight it would appear that the screw controlling this important movement has to bear the entire weight of the body of the instrument,

Fig. 4.



as in the Continental models. This is a common error, but not in accordance with fact. The turning of the milled-head screw actuates a hardened steel lever B, varying in length according to the size of the instrument, the fulcrum C of which is placed as closely as possible to the sliding fitting in which the movement of the body takes place, which reduces the weight carried by the milled head to considerably less than

in any other form. For instance, in our Edinburgh Student's Microscope—a section of a limb of which is shown in fig. 3—the total length of the lever arms is $2\frac{1}{16}$ in., the arm on the one side being 3/8 in. long, and on the other $1\frac{1}{16}$ in. The weight of the body, fittings, &c., is 17 oz. The resistance at the end of the lever is therefore $3\frac{3}{4}$ oz. We have not included the reactionary spring in these figures, as this is employed in all forms of fine-adjustment, but the resistance of this is minimized at the point of force, in the same ratio as the weight. Also by means of the long lever an extremely slow motion is obtained, the movement being lessened in the same proportion as the weight.

All fine-adjustments must wear in course of time as the result of friction, and in the majority of cases it is irremediable, except in the maker's or a skilled mechanic's hands. In our form the fitting is sprung and has two screws (shown in fig. 4, A), by means of which any wear as the result of friction can be at once taken up by the user. This is of the greatest importance to residents abroad, the necessity of returning an instrument to be adjusted being obviated.

The coarse-adjustment fitted to our instruments is as shown in fig. 4, and is effected by means of a diagonal rack and spiral pinion, which ensures the smoothest possible motion and an entire absence of backlash, the teeth of the pinion never leaving the rack. High powers can be exactly focused by its means without the aid of the fine-adjustment. This adjustment and all the frictional parts of the instruments are fitted with screws, as in the fine-adjustment, which by being very slightly turned compensate for wear and tear."

Note on Watson's Edinburgh Student's Microscope.—Mr. E. M. Nelson read the following note at the November meeting:—"It will be remembered that a certain amount of controversy was raised with regard to a Microscope exhibited here by Messrs. Watson and Sons last year.* I am now alluding not to the general design of that instrument, but solely to the fine-adjustment. Whatever the general design of an instrument, or however simple or complex its movements may be, its real value for work entirely stands or falls with the quality of its fine-adjustment. It is well to remember the axiom propounded by the late T. Powell, 'that a Microscope without a fine-adjustment, but with a good coarse-adjustment, is to be preferred to one, however elaborate, with a bad fine-adjustment.'

The question in dispute, therefore, is of supreme importance. At that time my opinion with regard to the fine-adjustment was asked, but, never having seen it, it was impossible for me to express any opinion on the subject. Since then Messrs. Watson and Sons wrote to me, saying that they were confident of the soundness of the principle of their fine-adjustment, and that if I would examine one, they would submit an instrument for my prolonged investigation. To this I agreed, and I am now in a position to answer the question asked last year regarding this fine-adjustment.

The adverse critics said that this fine-adjustment was on the Zentmayer plan, and as the Zentmayer fine-adjustment was a miserable failure, this one must be a failure also. This might have been very

* This Journal, 1891, p. 434.

true had their premises been correct, but the fallacy of the criticism lay in the fact that this fine-adjustment is not the same as Zentmayer's.

The reason why Zentmayer's fine-adjustment broke down was because it had no sprung grooves; the slides worked in solid V-shaped grooves, so that in more or less time the effect of wear made itself apparent, the fitting became loose, and as there was no means of tightening it up again, the Microscope in the end became only fit for the proverbial dust-bin.

The essential point of a Microscope is the springing of the dovetail grooves, and, so far as I am aware, it is to Messrs. Powell and Lealand that 'microscopy' is indebted for this valuable invention or adaptation. Whether springing of dovetail grooves was previously used in instruments other than the Microscope I am unable to say, but my impression is that Messrs. Powell and Lealand were the first to use it in the Microscope. Now, in Watson's Microscope we have two sprung slides, one for the coarse-adjustment, and one for the fine. The moment either movement exhibits the slightest sign of wear the slack can be immediately taken up by tightening the screws. There is no reason, therefore, why in years to come this instrument should not work as well as it does to-day. There is one point, however, which must be mentioned, and that is the weight of the body and of the coarse-adjustment slide is thrown on the fine-adjustment lever. It differs, therefore, from Powell's, inasmuch as the fine-adjustment in this instrument moves the whole body, whereas in Powell's it only moves the nose-piece. Strictly speaking, in this instrument there is no nose-piece at all. In general, a Microscope which has much weight on its fine-adjustment is to be regarded with suspicion. All who have had much to do with the Microscope know painfully well how soon the fine-adjustments of the Continental Microscopes, which have a considerable weight of brasswork thrown on a delicate screw, become useless. Here the Campbell differential screw with its strong threads has come to the rescue. In Watson's instrument we have a somewhat similar compensation: the arms of the lever being $1 : 4\frac{1}{2}$, the weight which ultimately falls on the fine-adjustment screw is reduced in that proportion. It must be remembered, too, that we are not now dealing with such large or heavy tubes as in the Powell instrument, but with far smaller and lighter tubing. The actual weight on the screw is, I am told, a trifle under a quarter of a pound,* which is, of course, not excessive. This instrument may be said to be identical with what may appropriately be called Swift's No. 2, with this difference: in Swift's the lever is parallel to the body, and in this it is at right angles to it. In Swift's side-lever No. 1 the instrument had a nose-piece, which only was moved as in the Powell; in his No. 2, however, both the body and the coarse-adjustment slide were moved; but in his No. 3 or present form only the body is moved. A lever at right angles to the body has two advantages over a side-lever, the first being that the screw-head is as conveniently placed for use with one hand as with the other; and the second is, that for photomicrography, the gearing to the focusing rod is more simple and direct.

There is one very ingenious and novel adaptation in this instrument which I would like to bring to your notice; the fine-adjustment screw is

* When the tubes and coarse-adjustment pinion-heads are made of aluminium this will be further reduced.

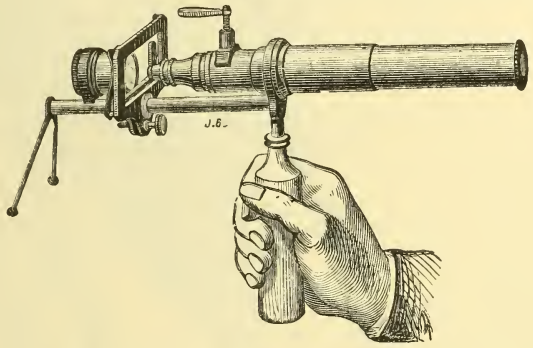
a left-handed one, therefore the movement of the nose-piece follows the *apparent* movement of the screw. In other words, when you think you are turning the screw downwards you are in reality raising it, and by doing so you are lowering the nose-piece.

This plan removes the single objection to the Powell plan of fine-adjustment, viz. the reversal of the movement, which is confusing until the idea is overcome by practice.

I have brought this to the notice of the Society, as I feel sure they have no wish to disparage any instrument which may be brought before them by an erroneous criticism founded on a misconception of its construction."

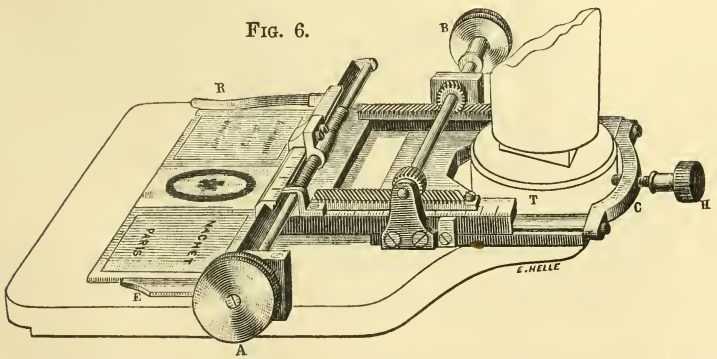
Nachet's Hand-Microscope.—This instrument, shown in fig. 5, is intended for circulation amongst an audience. Contrary to the usual arrangement in Microscopes, the preparation is held on its upper surface

Fig. 5.



by the stage in such a way that the different preparations are at once brought into focus when this has been regulated once for all. For finding the point of the object which it is required to demonstrate, the instrument can be adjusted on a base-plate, and can be separated again for circulation amongst the audience.

Fig. 6.



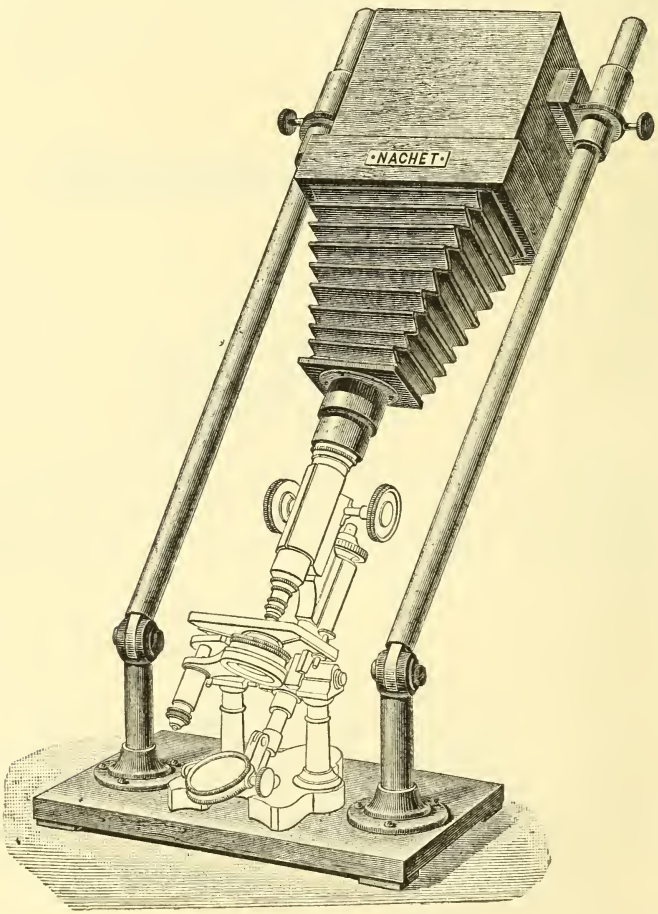
Nachet's Movable Stage.—In this stage, represented in fig. 6, two carriers, perpendicular to one another, move the preparation in all

directions. The latter is simply placed upon the stage and is held firm by the pressure of the spring on the right against the stop on the left. The forward movement is effected by the rack and pinion, and the lateral by the transversal screw. As seen in the figure the apparatus is attached to the ordinary stage by a screw pressing against the column of the slow motion.

(3) Illuminating and other Apparatus.

Nachet's Camera.—The new camera, shown in fig. 7, is mounted on two columns of nickelled copper on which it can be raised to different

Fig. 7.

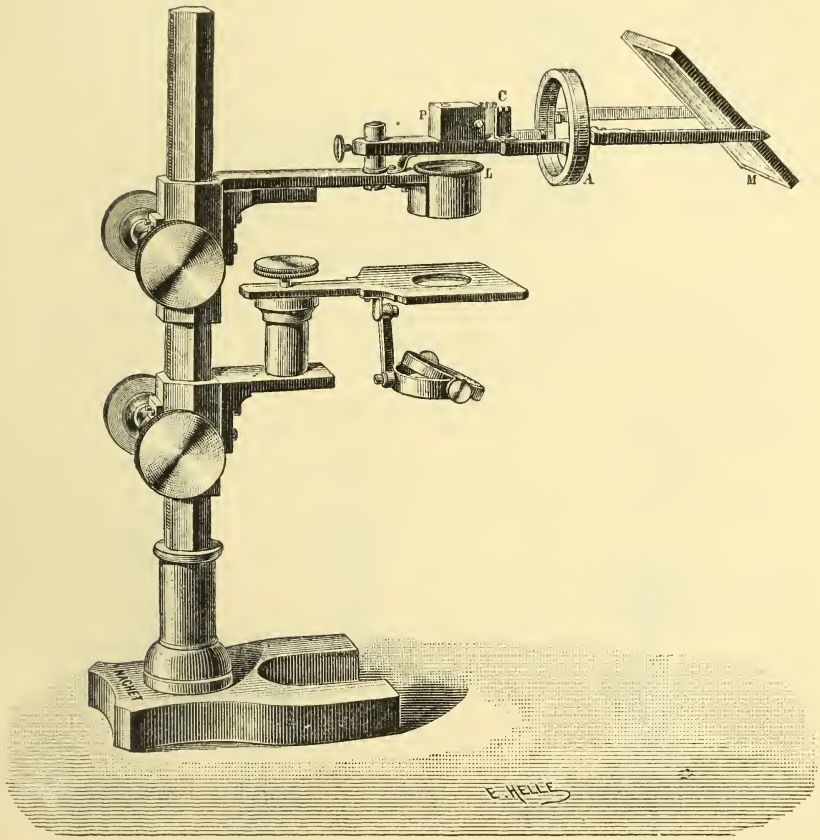


heights above the Microscope. The columns are hinged so that the camera can be inclined at any angle.

The bellows carries a union formed of two pieces, one fixed on the camera and the other screwed on the body-tube of the Microscope. These two pieces are free, one in the other, so that the movements given to the Microscope are independent of the camera.

Nachet's Camera Lucida.—The instrument seen in fig. 8 is a modified form of the camera lucida described in this Journal, 1887, p. 619. It carries two racks, one for adjusting the camera lucida, the other for

Fig. 8.



adjusting the stage beneath the lens P. The modifications in this model consist:—

(1) In the addition of a stage adjustable in height so as to bring the object into the focus of the lens, while the camera lucida is kept at the same distance from the table on which the drawing is to be made.

(2) In the possibility of drawing beneath a very weak lens, objects placed on the table beneath the mirror. For this purpose the stage is

removed and replaced by a small table provided with supports for the hands.

(3) By turning the ring, the mirror passes from the horizontal to the vertical plane, and it is possible thus to reproduce beneath the same weak lens any object placed vertically in front and to reduce it to any extent required. The small frame in front of the prism is for the reception of convex or concave glasses for the correction of parallax, or for tinted glasses intended to equalize the illumination of the object and the paper.

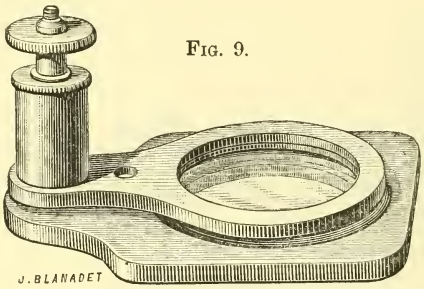


Fig. 9.

Nachet's Compressor.—The advantage of the model shown in fig. 9 is that all the points of the object are compressed equally owing to the two surfaces of glass being parallel to one another.

Fig. 10.

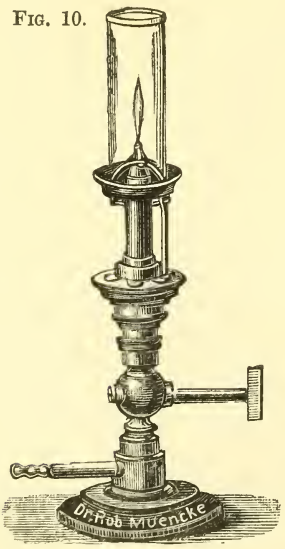
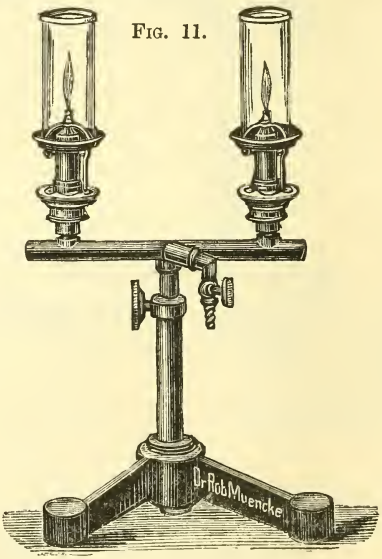


Fig. 11.

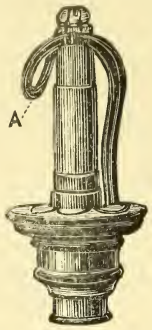


New Microscope-Lamp as Safety Burner.*—Herr P. Altmann describes a new lamp for heating drying ovens, &c., which in point of

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 786-7.

safety possesses some advantages over those in ordinary use. The automatic arrangement for cutting off the gas when the flame, by accident or otherwise, has been extinguished is novel and ingenious. Fig. 10 shows a single burner as used for small thermostat, and fig. 11 a double burner for heating ordinary cultivating ovens. To light the burner, a match is applied for some seconds to the lower part of the loop at A (fig. 12). The vapour tension, resulting from the heating of the bent tube, acts upon a metal membrane which opens the gas valve, and keeps it open as long as the flame is burning. Should, however, the flame by any accident be extinguished, the temperature of the tube falls, the hydraulic pressure is diminished and the gas-valve is again closed.

Fig. 12.



An Improved Form of Dr. Edinger's Apparatus* for Drawing Objects under Low Powers.—Mr. E. M. Nelson writes to us:—"The following is a description of the instrument made and exhibited for me by Mr. Curties, at the special exhibition on November 30th. My improvement consists in securing a far larger angle from the source of illumination and then condensing it so that it may all pass through the front lens of the objective, which on that occasion was a Zeiss *aa*. This increased illumination will, I think, be found to be an improvement on Dr. Edinger's method.

On referring to fig. 13 it will be seen that the magnified image of the object is projected on the paper so that there is no troublesome camera or other apparatus to look through, and no previous knowledge or practice in drawing is necessary.

The outline of the image is directly traced on the paper on which it is projected, in the same way that a magic lantern view might be traced on the sheet on which it was cast.

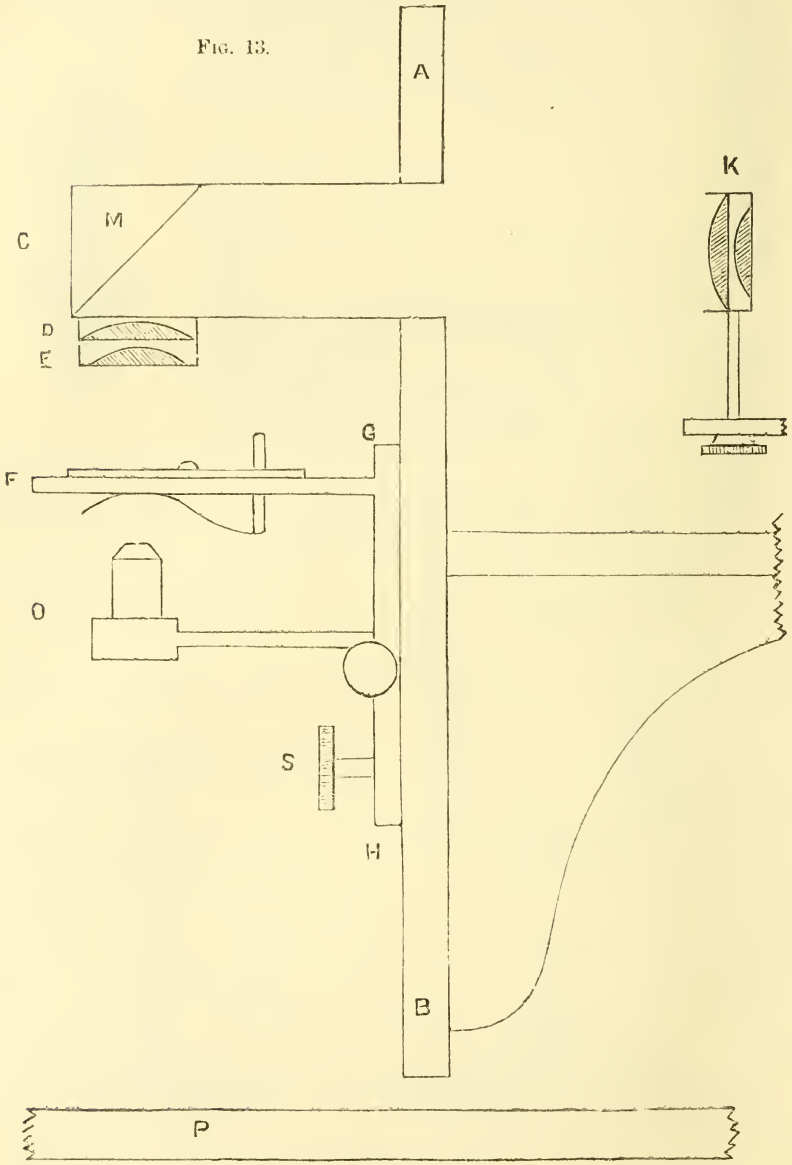
The instrument consists of a vertical board A B, with a tube C fitted at right angles to it; this tube has a mirror M of common looking-glass fixed at an angle of 45°. Below this there is a specially constructed condenser D E, consisting of two lenses D and E such that either of them can be used independently or they may be used together as in the figure. For very low powers the large lens D is alone used, for higher powers the small one E, while for still higher both D and E are used together. T is a simple stage, the slide being held against the lower side of it by spring clips. On the upper side there is a wheel of diaphragms; the use of this wheel of diaphragms is totally distinct from that in an ordinary Microscope, where its office is to regulate the angle of the cone of illumination, because here it merely limits the size of the field. O is the objective (for a medium power a Zeiss *a a* will be found very suitable). Both the objective-holder O and the stage F are fixed to a separate block GH which slides in grooves on the board AB, and is clamped by the screw S.

This arrangement allows the stage and the objective to be placed at a proper distance from the condenser. The illumination of an object in projection, especially in low power projection, differs essentially from

* See this Journal, 1891, p. 812.

that in ordinary microscopical work; in the latter a critical image is obtained by focusing the light on the object, but here the light should

Fig. 13.



be focused on the *front lens* of the objective. O is fitted with rack-and-pinion focusing adjustment. At the back of the board A B there is a

bracket to hold an ordinary Microscope lamp with an attached bull's-eye. Only the bull's-eye K (one of my doublets) is shown.

Finally the board A B slides in uprights on the base P (not shown); this is to allow the magnification to be altered by increasing or decreasing the distance between the objective and the paper on the base-board P on which the drawing is to be made. To use the instrument, in the first instance the bull's-eye K is focused to the edge of the lamp flame and parallel rays are sent on the mirror M. The condenser suited to the power is arranged at D. The distance between K and D should not be less than 12 in. Having placed the object in the clips on the stage, and having roughly focused the objective, the screw S must be loosened and the whole block G H moved up or down so that the rays from the condenser are focused on the objective. The field is then limited by the wheel of diaphragms. The illumination from an ordinary Microscope lamp with a 1/2 in. wick will be found sufficient when the apparatus is used in a darkened room, but if scattered light interferes with the image, cloth curtains may be provided to shield it off. This instrument was shown on the evening of the special exhibition with oxy-hydrogen illumination, a miniature jet and zirconium disc being employed, by which means sufficient light was obtained although the room was lighted by electricity.

The instrument gives an inverted and transposed image, the drawing is therefore precisely as it is in nature, which is not the case in some cameras which correct the inversion but leave the transposition."

(4) Photomicrography.

Nachet's large Photomicrographic Apparatus.—In this apparatus, represented in fig. 14, the two slide-ways superposed allow of a separation of 2 m. between the objective of the Microscope and the sensitive plate. The camera, measuring 18 by 24 cm., is divided into two parts connected by bellows of equal length. The front portion carries a special chamber with which the body-tube of the Microscope makes a light-proof connection. In the upper part of this chamber, at O, there is a lid which allows of the adjustment of the projection eye-pieces.

Exact focusing is effected by means of the rod CT in connection with an endless screw R, which engages in the wheel H, placed in front of the screw-head of the slow motion, and connected with it by a spiral spring of such resistance that the motion may be communicated to it instantaneously and without vibration. The connection between the rod and tangent screw is of the same kind. The extremity of the upper slide is provided with a levelling screw V to keep it in contact with the table on which the apparatus is placed. On this table are placed the different illuminating apparatus: heliostat, oxy-hydrogen lamp, ordinary lamp, &c.

Bousfield's Photomicrography.*—The second edition of this guide to the science of photomicrography has just appeared. It has been entirely rewritten and much enlarged. It is extremely well got up, and the illustrations, including specimens of photomicrography, are frequent. For those more interested in photographing histological and bacterio-

* J. and A. Churchill, London, 1892, pp. 174, 34 figs. and 1 pl.

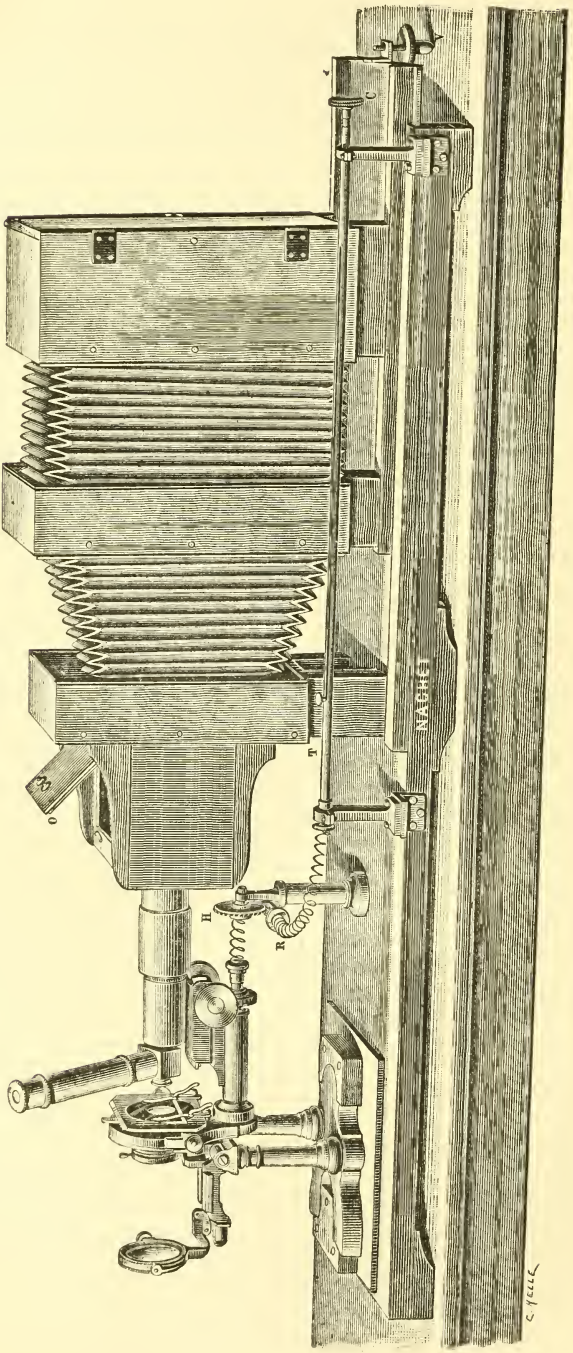


FIG. 14.

NACHET'S LARGE PHOTOMICROGRAPHIC APPARATUS.

logical specimens this work will be very useful, as most of the space is devoted to such preparations, the photographing of diatoms being only mentioned.

At the end of the work is an appendix, showing how to prepare objects to be photographed.

Podura Scale.—The following is the text of the remarks made by Mr. T. F. Smith at the Society's meeting last November (see this Journal, 1892, p. 908), which were illustrated by several photomicrographs:—

In the papers read 16th December last and March 16th by the Hon. J. G. P. Vereker and Dr. A. Clifford Mercer on the subject of the structure of the Podura scale there is a direct conflict of evidence, in so much that while Mr. Vereker describes the structure as consisting of a hyaline beaded membrane having minute featherlets inserted in it, such featherlets being forked at the end, Dr. Mercer has seen nothing in the shape of spines or featherlets projecting from torn or folded scales, and doubts their existence. At the last meeting of this Society Mr. H. L. A. Wright throws his weight on the side of featherlets, but the evidence offered in support of this seems to have been of such an inconclusive character as to leave the question exactly as it stood before. It was my good (or bad) fortune some two or three years ago—when perhaps I was a little more sanguine of being able to solve the mystery of the scale than I am now—to devote a great deal of attention to this subject, and gained a little positive knowledge which I beg to offer to-night in hope the evidence produced may be able to carry the matter one step further.

In estimating the value of the evidence already given us, it is necessary to consider the circumstances under which the images were produced; and here I cannot help thinking that both observers have failed to take due advantage of the modern methods of illumination, or to get the best performance out of the objectives in their hands. Mr. Nelson's remark when discussing Mr. Vereker's paper, that the method of illumination used reduced the performance of an oil-immersion to rather less than a dry objective is so forcible and so true, that it would be an impertinence for me to add to it; but from internal evidence offered by the reproduction of the prints referring to the Podura, I should say that Dr. Mercer has also been governed too much by the conventional appearance of the scale, and produced only the ordinary "exclamation marks" with the light streak on them, with which we have been so familiar for the last forty years.

Now there are only two conditions under which you can produce these appearances with an oil-immersion. First, if the scale is on the cover you must throw the objective so much out of adjustment that the resulting image is valueless; or, secondly, if the scale is on the slip, there is an air-space between it and the cover, and the lens performs, as Mr. Nelson says, rather worse than a dry objective.

I submit two prints * here in support of my remarks—Nos. 1 and 2: No. 1 taken with a dry 1/6-in., and showing the usual "markings," and No. 2 taken with Zeiss's 2-mm. apo. of 1·40 N.A., and in a fixed setting for a 160-mm. tube. In No. 2 you see the conventional "markings" have disappeared altogether, and in their place appears a series of

* Copies of these prints are in the Society's Library.

white pin-like forms with secondary structure between. Now I offer no opinion as to the truth of the whole of the appearances, but only produce it as an example of what an oil-immersion objective of large aperture shows when working at its best.

Print No. 3 shows a scale folded over, and two of the same pin-like bodies projecting nearly their whole length from the line of the fold. No. 4 also shows a scale folded over, and there the projections, although less pronounced, are still visible. On No. 5 I show three or four of the "pins" separated from the scale altogether, and I think there is sufficient evidence in the last three prints to prove that they are real, and not ghosts.

But this is not the whole of the structure, and what that whole is it is not at present for me to say, nor do I early expect to, but I am still collecting evidence, and hope to carry the matter still a little further at an early date.

(6) Miscellaneous.

The late Sir Richard Owen, K.C.B., F.R.S.—Although the Fellows will have read numerous obituary notices of this distinguished naturalist, they will expect to have, in their own Journal, some account of the man who was the first President of the Society. Although he does not appear to have been among the most constant of those friends of Dr. Bowerbank who met at the latter's and at one another's homes to discuss microscopical problems, his abilities and his position marked him out as the first President of the Society which grew around that nucleus, so that he occupied the chair in 1840 and 1841, and delivered the first two Presidential addresses. He retained throughout life a warm interest in the affairs of the Society, and none expressed more warmly than he his satisfaction at the improvement in the prospects and activity of the Society, which has been so remarkable during the last fifteen years. His own most important contribution to the microscopical side of his science is to be found in his large work on 'Odontography,' illustrated by 168 beautiful plates, many of which are devoted to the details of the minute structure of the teeth of Vertebrates.

Born in 1804, on July 20th, originally of Huguenot extraction, and endowed with the constitution, both physical and mental, of a giant, Owen probably produced, single-handed, a larger amount of descriptive work than any other naturalist. Although, in recent years, he was regarded as a conservative, if not an obstructive, he was full to the brim of a philosophical desire to generalize and to speculate. If we say that he generalized about things different to those on which, say Prof. Haeckel or Mr. Romanes speculate, we are, after all, only saying that men and times change. His acuteness in solving palæontological problems has almost become a proverb. Of his speculations some have been shown by later discoveries to have been justified, some have had to be modified, others to be decisively rejected; but, it is to be remembered that Owen was a philosophical as well as a descriptive naturalist. As was well said by Prof. Huxley, he was not only the continuator of Cuvier, he belonged also to the philosophical school of Geoffroy Saint-Hilaire and Oken.

With regard to the branches of Zoology which he studied, his range

extended from the Sponge *Euplectella* to the manlike Gorilla and to Man himself; in every division of the Animal Kingdom he made researches of prime importance to the student of Comparative Anatomy; some divisions thereof, such as the Fossil Reptiles, the Dinornis, the Fossil Mammals of Australia, the Marsupials, were for years almost his especial property. His generalizations extended from the wide difference between analogy or functional, and homology or structural resemblance, to the morphology of the digits of odd- and even-toed Ungulates. Even those philosophical speculations which have been universally rejected are still recognized as the cause of investigations in himself and others.

Though a man of the most pronounced individuality of character, his affection and esteem for those who preceded him, and especially for Georges Cuvier and John Hunter, was intense, and was a distinct note of his personality.

When the history of sanitary science in this country is written the name of Owen will be found associated with that of Edwin Chadwick and John Simon. To the lovers of Natural History he will, for generations to come, be remembered as the prime mover in the erection of the splendid edifice at South Kensington, which is now the "National Museum of Natural History."

To those who had the benefit of his personal acquaintance, his loss is one that it is difficult to express in words; those who did not know him at home had no idea of the lovable and affectionate nature of one who will, perhaps, be for all time the greatest zoologist our country has produced.

Bacteriological Department of King's College.—Most of the Fellows will remember one of the last of our Conversazioni held at King's College, when Prof. Crookshank opened his Bacteriological Laboratory for our inspection, and they will read, therefore, with interest the report lately made to the Council of the College by the Principal and the Dean of the Medical School.

"The rapid development of bacteriology has been one of the most remarkable events in the history of medical progress during recent years. Ten years ago bacteriology was only represented by researches which excited scientific interest when published, but the subject did not form a part of the training of a medical student, nor was any knowledge of it regarded as essential to the general medical practitioner. The discoveries which rapidly followed in Germany and France, and the establishment of classes of instruction for medical practitioners and scientists in Germany, created a demand for similar instruction in this country. During the past five years that demand has increased, until bacteriology has come to be recognized and taught as a distinct branch of medical science; and in London and the provinces opportunities for carrying on original research have been provided at public health institutions and in the medical schools.

From the report which follows of the work of the Bacteriological Laboratory of King's College, for the six years since its foundation, it will be seen that not only was King's College the pioneer in providing a laboratory devoted to this special branch of medical education, but the laboratory continues to maintain a unique position in giving systematic teaching on this subject in England. In 1886 the Council resolved to

meet the great demand, which existed at that time and has since increased, for courses of lectures and practical instruction in bacteriology. Mr. Crookshank, a former pupil of King's College, accepted the Lectureship, the first appointment of its kind in this country, and accommodation for practical instruction was provided in one of the class-rooms of the physiological laboratory. The success of these classes was so great that the Council resolved to provide special and permanent accommodation for the courses of instruction, and to grant facilities also for original research. For this purpose the Council created a department distinct from that of physiology, and one of the largest lecture-rooms in the College, admirably adapted for microscopical work, was converted into a teaching and research laboratory and lecture-room, and additional rooms were built for the Professor and to complete the necessary accommodation. The laboratory was duly licensed for research, and Mr. Crookshank was promoted to the newly created professorial chair; and with the aid of a contribution from him of 1000*l.* towards the expenses of the laboratory, the Council were able, without any loss of time, to completely equip the laboratory with all the fittings, instruments, and material necessary for the investigation of the diseases of man and the lower animals, and for the study of bacteriology in all its applications.

To enter as a pupil, or for the purpose of undertaking original investigation, it is not necessary to have had any previous connection with King's College. The laboratory has been opened to all, and, as set forth in the original syllabus, special inducements were offered from the very first to medical men in practice, medical officers of health, analysts, medical and veterinary officers of the services, and any others whose duties might prevent a daily attendance.

It will be a source of satisfaction and gratification to the Council to learn that, from the foundation six years ago up to the date of this report, the number of students qualified and unqualified who have entered the laboratory for instruction or for research amounts to 419. This number comprises general practitioners, army and navy surgeons, medical officers of health, analysts, biologists, veterinary surgeons, and veterinary and medical students. A few have previously been connected with the College or Hospital; a great number have been qualified medical men from the United States; others have come from New South Wales, Queensland, Tasmania, China, India, Ceylon, Chili, Cape of Good Hope, and Trinidad; and if the medical officers of the army and navy on leave from foreign service are added to this list, they will serve to illustrate how widely the laboratory is known, and the Council will realize still more fully how great a want existed, and that it has been met by their action.

It will be still more gratifying to refer somewhat in detail to the work done in the laboratory as regards original research and work on behalf of the State. Among the first to make use of the laboratory in connection with work for the Government may be mentioned Prof. Brown, C.B., of the Board of Agriculture. The Hon. H. N. MacLaurin, M.D., President of the Board of Health, New South Wales, passed through a course of instruction, and paid special attention to actinomycosis. On his return he continued his observations, and published them in the Official Reports of the Board. Mr. Park, Government Veterinary Surgeon, Tasmania,

came over to study bacteriology, particularly actinomycosis and tuberculosis, and was thus enabled to make valuable reports and suggestions at the Australasian Stock Conference. Prof. Anderson Stuart, of Sydney, passed through a special course of instruction, and investigated the tubercle bacillus, preparatory to proceeding to Berlin to study Koch's treatment of phthisis. His researches were published in an exhaustive report to the Government, and the assistance which he received in this laboratory was acknowledged in the preface to his report. [Others follow for which we have no space.]

Important researches have been carried out on behalf of the Agricultural Department of the Privy Council—now the Board of Agriculture—and Prof. Crookshank, who undertook these researches, received in 1890 the thanks of the Privy Council. The results were published in the following reports:—(1) Report on the so-called Hendon Cow Disease and its relation to Scarlet Fever in Man. (2) Report on a Micro-organism alleged to be the contagium of Scarlet Fever. (3) Report on Anthrax in Swine. (4) Report on Tubercular Mammitis in Cows and the Infectivity of the Milk. (5) Report on Actinomycosis in Cattle in Great Britain. (6) Report on Actinomycosis in Man in Great Britain. (7) Report on Actinomycosis in Cattle in Foreign Countries. (8) Report on Actinomycosis in Man in Foreign Countries. (9) Report on Cowpox and Horsepox.

The Council will see from this Report that original investigation has been a very important part of the work conducted in the Laboratory of King's College since its foundation; but as a department of King's College, it is especially necessary at the present time to lay stress upon the fact that it has occupied and still retains a unique position in this country as a teaching institution. It was not only the first laboratory established, but it always has been, and still is, in marked contrast to the bacteriological laboratories attached to the pathological department of some of the medical schools, in that systematic courses of instruction are regularly given throughout the whole academical year, and are open to any one. It is a public laboratory, and as such has already attracted a large number of workers, not only from London and the provinces, but from our colonies and other countries.

It will not be out of place in this report to add that Prof. Watson Cheyne, previous to the creation of a surgical pathological laboratory, made use of the bacteriological laboratory for a part of his work on tubercular disease of bones, and Prof. Ferrier also, pending the equipment of a neurological laboratory, performed there some of the experiments which were published in his most recent work on Cerebral Localization."

β. Technique.*

Behrens' Introduction to Botanical Microscopy.† — This work differs considerably in its scope from the standard work for the botanical laboratory, Strasburger's 'Botanisches Praktikum.' The latter is chiefly

* 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.

† 'Leitfaden der botanischen Mikroskopie,' Braunschweig, 1892, 208 pp. and 150 figs.

concerned with the best modes of treatment of a great variety of botanical preparations and tissues, and with the demonstration of processes of botanical physiology, which it takes up in succession and in considerable detail. The work under review is rather a guide to the use of the Microscope by botanists, applicable to the whole scope of his investigations, and may be regarded as a supplement or companion to Strasburger's work. The first section is concerned with the Microscope as an instrument, and with microscopical appliances, and contains nothing that will not be found in ordinary English text-books. The second and larger portion is a guide to the preparation of botanical objects for the Microscope, and treats the subject more in detail than do English treatises, including the most recent methods recommended by the best workers. Here will be found directions for hardening, fixing, clarifying, and softening, the preparation of botanical sections, the use of staining materials, the preservation of the sections when made, and similar daily needs of the microscopical botanist. For the fixing of algæ, and of the protoplasmic contents of the higher plants, Ripart's fluid is recommended, consisting of 0·3 grm. cupric acetate, 0·3 grm. cupric chloride, 1 ccm. glacial acetic acid, 75 ccm. camphor-water, and 75 ccm. distilled water; for studies of the cell-nucleus a very dilute solution of gentian-violet, 0·3 grm. dissolved in 100 ccm. of absolute alcohol, and this again diluted with 1000 times its volume of distilled water.

(1) Collecting Objects, including Culture Processes.

Preparing Nutrient Bouillon for Bacteriological Purposes.*—Herren Petri and Massen give the following for preparing bouillon:—Fresh chopped meat containing little fat is soaked for one hour in the necessary quantity of distilled water. It is next heated for three hours at about 60° C., after which it is boiled for half an hour and filtered. When cold the degree of acidity of the fluid is tested from samples of 10–20 ccm. As a rule 10 ccm. require by the litmus reaction 1·8 ccm.; by the phenolphtalein reaction, 3 ccm. of 1/10 normal caustic soda solution. The broth obtained from the meat of different animals did not present any striking differences. After the addition of alkali pepton and salt it is boiled for some time, best over the open fire for a quarter of an hour, and then filtered hot. Too long and too frequent boiling are to be avoided. The bouillon and the medium prepared from it are to be kept in the dark.

Degree of Alkalinity of Media for Cultivating Cholera Bacilli.†—Dr. M. Dahmen made a series of experiments to determine the most suitable degree of alkalinity for the cultivation media of cholera bacilli. From them he concludes that for the examination of fæces for cholera bacilli a gelatin with 1 per cent. of soda is the most suitable, and that a faintly alkaline medium is not only not sufficient, but absolutely unsuitable.

Method for Sowing Bacteria on Gelatin Plates and other Surface Media.‡—Dr. P. Troppau practises the following device for sowing

* Arbeiten aus d. Kaiserl. Gesundheitsamte, viii. No. 2. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 484.

† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 620.

‡ Tom. cit., pp. 653–4.

germs on nutritive media. The bacteria to be cultivated are first disseminated in a small quantity of sterilized water, and some of this is then run over the plate, made of gelatin, serum, vegetable albumen, and the like. The capsule and plate are then placed under the bell of a powerful air-pump. If this work well the water is soon evaporated, leaving the germs behind scattered all over a smooth surface. Care must be taken not to make the surface too dry. This procedure is said to offer the advantage of allowing the inspection of the characteristic shape of superficial colonies at very early stages. Inoculations are easily made from any particular colony, and counting the colonies is much facilitated.

Culture of Diatoms.*—Dr. P. Miquel states that a very favourable medium for the artificial culture of freshwater diatoms is ordinary fresh water in which have been thrown stems of grasses, the cortical substance of grains of wheat, barley, or oats, fragments of Muscineæ, &c.; soluble carbohydrates, albuminoids, &c., have an injurious rather than a favourable influence. The presence of a very small proportion—from 1 to 5 per mil.— of certain salts, such as those of soda, potash, or lime, in the condition of chlorides, bromides, iodides, phosphates, and sulphates, has a marked favourable effect on the multiplication of diatoms; but they appear to prefer to obtain their silica from that set at liberty by the decomposition of plants rather than from soluble silicates. The marine kinds are easily cultivated in artificial sea-water, especially if containing fragments of *Fucus* or other sea-weeds.

In another paper on the same subject, the same author † gives full instructions as to the best mode of cultivating diatoms, both freshwater and marine, the best media for their growth, the most favourable temperature, light, &c. The most destructive enemies to diatoms are bacteria. An apparatus is described for their culture free of bacteria.

Cultivation of Diatoms.‡—Dr. L. Macchiati, in a preliminary communication, points out that diatoms are easily cultivable in the nutritive solutions used in vegetable physiology, provided that a few drops of silicate of potash be added to the medium. Or the very water which the diatoms inhabit may be used. This, when filtered, and with the addition of a few drops of strong silicate of potash solution, forms an excellent fluid. The medium, placed in a watch-glass, is then inoculated with a loopful of the water inhabited by the diatoms, and the two fluids having been thoroughly mixed together by stirring, a loopful of the mixture is placed on the surface of a cover-glass, the exact thickness of which is previously ascertained. To the margin of the cavity of a hollow-ground slide is then applied some vaselin, and this is carefully placed over the cover-glass. The slide, now containing a hanging drop cultivation, is turned over.

In such a drop the diatoms are in an almost natural state, and their development and mode of life may be watched under a power as high as 1/18, though the lens commonly employed by the author is a dry apochromatic with focal distance of 4 mm. and N.A. 0·95. In combination

* Comptes Rendus, cxiv. (1892) pp. 780–2.
† Le Diatomiste, 1892, pp. 73–5, 94–9, 121–8, 149–56 (3 figs.).
‡ Journ. de Micrographie, xvi. (1892) pp. 116–20.

with eye-pieces 6, 12, 18, magnifications of 372, 750, and 1125 were obtained.

The best part for observing the diatoms is the edge of the drop, and this should be first centered under a low power.

Preparing Litmus Tincture for Testing Reaction of Gelatin.*—According to Dr. M. Dahmen, a very sensitive litmus solution may be prepared from Mohr's formula. The litmus is to be thoroughly worked up with hot distilled water; the filtered solution is then evaporated, and having been treated with acetic acid to saturation, is again evaporated down to the consistence of a thick extract. This mass is then placed in a flask, and a large quantity of 90 per cent. alcohol added. The blue pigment then precipitates a red dye and acetate of potash remains in solution. The litmus is next filtered off, and having been washed with alcohol, is dissolved in warm water and again filtered. The solution must be kept in vessels stopped with cotton-wool, as in tightly-closed bottles it soon loses its colour.

Sterilizing Incoagulable Albumen.†—M. E. Marchal suggests that the action of certain salts may be utilized to prevent the coagulation of egg albumen when heated to 100°. These salts are borate of soda, sulphate of iron, and nitrate of urea. The following are the quantities of these substances to be used for the purpose:—Solutions of 2 to 5 per cent.:—Borate of soda, 0·05 grm. per litre; sulphate of iron, 0·001–0·006 grm. per litre. Solutions of 10 per cent.:—Nitrate of urea, 4 to 5 grm. per litre. Thus prepared, the liquids may be sterilized at 100° in cultivation flasks.

It is hardly necessary to point out that nitrate of urea should not be used to prevent the coagulation of albumen if the experiments relate to nutrition or fermentation of matter containing albumen.

Sterilization of Water by Pressure.‡—MM. Rouart, Geneste, and Herscher have constructed an apparatus for sterilizing water effectually and economically by a combination of heat and pressure. It consists of four distinct parts—a boiler, primary and secondary converter (or cooler), and a clarifier. The water to be sterilized is introduced into the primary converter—a cylindrical metal vessel surrounded by a worm in which water heated to 120°–130°, and just coming from the boiler, is circulating. From the converter, and having there been raised to 100°, the water is conducted along a pipe to a worm running round the boiler, where it is heated up to 120°–130°. From this worm the water then passes through the worm in the primary converter, thence through the secondary converter, and finally, having passed through the clarifier, completes its circuit. The secondary converter is also a worm surrounded by cold water, and might be termed the cooler. The clarifier is filled with powdered silica, apparently between layers of canvas, and is not intended for a filter, but to impart a clearness or limpidity to the water which has been removed from it by the heating it has gone through. The water having passed through the clarifier, is delivered bright and clear, and fit for all the purposes of life.

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 622.
† Bull. Acad. Roy. Sci. de Belgique, xxiv. (1892) pp. 323–7.
‡ Journ. de Microgr., xvi. (1892) pp. 145–52 (2 figs.).

Thermo-Regulator for Petroleum Heating.*—Dr. P. Altmann describes an apparatus by which a thermostat can be maintained at a constant temperature where the source of heat is not gas. It consists of a contact thermometer, the tube of which is immersed in the water space of the incubator. At the top of the tube is a box with dial and two hands, one of these is fixed at any desired temperature. As the temperature of the incubator rises, the free hand moves until it touches the fixed hand. This makes an electric contact, and a current passes to the other part of the apparatus. Here by means of an electromagnet and a lever two mica plates are made to close over the lamp in such a way that the heat is directed away. As the temperature of the thermostat falls, so does the free hand of the contact thermometer fall away from the fixed hand, and then the contact is broken, whereupon the mica plates fall back, and the heat reaches the thermostat again. The apparatus works quite automatically, and is said to maintain a constant temperature.

Apparatus for Obtaining Samples of Deep Sea Water and from the Sea Bottom.†—Mr. H. L. Russell describes an apparatus which he has used with very satisfactory results, for collecting samples of deep sea water. It consists of a large-sized test-tube, tightly fitted with a rubber cork, having a single hole. The opening in the cork is closed by a glass tube, which projects about 3/4 in. below the lower end of the stopper. The upper part of this small tube is bent at right angles to the long axis of the collecting tube, and drawn out to a fine calibre. The various parts having been carefully sterilized, are fitted together, and a partial vacuum produced either by means of an air-pump, or by just heating the tube. The end of the tube is then sealed. To prevent the ingress of air, the cork should be coated with a mixture of beeswax and resin.

Samples of water are obtained by clamping the tubes to a holder in such a way that the drawn-out end lies close to the connecting line. When sunk to the desired depth, a lead messenger is sent down the connecting line. This catches the end of the fine tube, breaks it off, and destroys the vacuum. The tube then fills with water. There is no danger of the sample getting mixed with water from other depths, as the tube is effectually stoppered by means of imprisoned air.

The apparatus used for obtaining material from the sea bottom consists of an iron tube (gas-pipe) pointed at one end. The other end is fitted by means of a screw with a removable "sleeve," the upper end of which is closed by a valve. As the weighted instrument descends, the water passes through the pipe, and when the bottom is struck, the pipe is forced into the soil, and so fills with a compact mass of material. When withdrawn, the water-pressure closes the valve, and prevents the contents from being washed out. Though the apparatus is theoretically imperfect, it practically delivers samples of the sea bottom quite uncontaminated.

Puritas Water Filter.‡—Dr. M. Jolles, from experiments with *Micrococcus prodigiosus*, finds that the Puritas Water Filter is only

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 654–5 (2 figs.).
† Bot. Gazette, xvii. (1892) pp. 312–21.
‡ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 596–605.

suitable for the filtration of waters which have not undergone sufficient natural filtration, and that it does not deliver a germ-free water.

Testing the Pasteur-Chamberland Filter.* — Drs. T. Smith and V. A. Moore show how, by a very simple contrivance, it can be demonstrated that the pores in the porcelain bougie are bigger than most bacteria. A bougie of the usual shape is put inside a long, pretty narrow test-tube, and the latter plugged at the top with cotton-wool. The combination is then dry-sterilized.

To show how the bacteria pass through, a flask of bouillon is inoculated with a pure cultivation of a species of bacterium, and having been incubated for some hours, is run into the filter by means of a sterilized pipette. The flask is then connected with an air-pump, and some of the fluid drawn through the filter until the latter is surrounded up to a certain height with a layer of fluid. The whole apparatus is then incubated. In a few days the bouillon becomes turbid.

The experiment may be reversed; that is, the fluid may be sucked up into the filter from without, but the details of the process are more complicated, and much less satisfactory.

Method for Differentiating between Bacilli of Typhoid Fever and Water Bacteria closely resembling them.†—Dr. J. Weyland examined some drinking water suspected of giving rise to enteric fever, and isolated therefrom a species of bacterium the morphological and cultivation characteristics of which were not to be certainly distinguished from those of true typhoid bacilli. The negative indol reaction served to increase the suspicion of their identity.

The author first set about comparing the vitality of these bacilli with those of real typhoid, but no notable differences were shown, and recourse was had to chemistry. As the bouillon cultivation of both kinds had an acid reaction, the amount of acid formed in 10 ccm. of milk serum was first ascertained. For this Petruschsky's method was adopted, but phenolphtalein was substituted for litmus as indicator. After having been incubated for three days, it was found that the serum inoculated with the real typhoid required 8–9·1 ccm. of 1/100 alkali solution to neutralize it, while the pseudo-typhoid took 12·9–15·4 ccm. The amount of carbonic acid formed by the two kinds of bacteria was then determined by Pettenkofer's method; this consists in forcing the carbonic acid formed by the bacteria into tubes filled with baryta water, and estimating the diminution of alkalinity by titration with oxalic acid.

The only caution to be observed is that the fermentation bulbs must be kept at similar temperatures, as the slightest difference in heat has an important influence on the production of carbonic acid. This part of the experiment lasted 10 days, and the result of it was that the pseudo-typhoid bacilli were found to have produced about five times as much carbonic acid as the true typhoid bacilli. A repetition of the experiment gave a similar result. It was accordingly determined that the water bacteria in question were not typhoid bacilli.

* Centralbl. f. Bakteriol. u. Parasitenk., pp. 628–9 (1 fig.).

† Archiv f. Hygiene, xiv. p. 374. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 338–9.

New Biological Test for Cholera Bacteria.* — Herr O. Bujwid finds that iodoform exerts considerable influence on the growth of cholera bacilli, and little or none on that of bacteria resembling cholera vibrios. If cholera bacilli be mixed with gelatin and placed in a test-tube, and then exposed to the vapour of iodoform the gelatin will remain unliquefied for 10 to 15 days, while in control tubes the superficial layers begin to be liquefied on the second day.

It is noteworthy that the quantity of iodoform in the vapour is so small, that even after 18 days no diminution in weight can be detected by most sensitive scales.

In 10 to 15 days liquefaction begins and proceeds, the iodoform notwithstanding. No like effect was produced by the following substances:—Camphor, naphthalin, hypochlorite of calcium, turpentine, thymol, phenol. Iodine has some, but much weaker, effect.

On the cholcroid bacteria, e. g. *B. Finkler-Prior*, *Vibrio Metschnikovi*, *B. Milleri*, *B. Denecki*, the effect is much weaker, and liquefaction is perceptible on the third day. The difference is little dependent on external conditions, and holds good for low and high temperatures, even for such at which the gelatin begins to liquefy; for the liquefied gelatin remained quite clear under the iodoform action, while the control gelatin is quite cloudy.

Old and new cultivations give the same reaction, and the author thinks that the action of iodoform should be added to the methods for distinguishing cholera bacilli from other bacteria, and that this might be known as the iodoform test.

Bacteriological Diagnosis of Cholera.†—According to Dr. Pfeiffer the only certain procedure for diagnosing cholera is by cultivating on the gelatin plate. Colonies of cholera bacilli can be certainly recognized in 24–36 hours, and more especially if the cultivations be made with dejecta in which liquefying bacteria are rare.

Bujwid's reaction with mineral acids is regarded as very uncertain and the presence of comma bacilli in microscopical preparations from suspected material should only be regarded as presumptive evidence. On the other hand, the method of Schottelius may be adopted in many cases, though if there be time it should be controlled by the plate method. Schottelius' method consists in mixing the material to be examined with a thick layer of bouillon, and as the cholera bacilli are strongly aerobic they grow on the surface, forming a delicate scum which is almost a pure cultivation.

Coplin, W. M. L., and D. Bevan—**A Test Reaction for the Culture of the Micrococcus pyogenes aureus.** *Med. Record*, II. (1892) p. 70.

Dei Santi, L. — **Note sur la stérilisation de l'eau par précipitation.** (Note on the Sterilization of Water by Precipitation.) *Compt. Rend. Soc. Biol.*, 1892, pp. 711-3.

Merke, H.—**Ein Apparat zur Herstellung keimfreien Wassers für chirurgische und bakteriologische Zwecke.** (Apparatus for producing Germ-free Water for Surgical and Bacteriological Purposes.) *Berl. Klin. Wochenschr.*, 1892, pp. 663–5.

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 595–6.

† Deutsch. Med. Wochenschr., 1892, No. 36. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 483–4.

Petri, R. J., u. A. Maassen—**Ueber die Bereitung der Nährbouillon für bakteriologische Zwecke.** (On the Preparation of Nutrient Bouillon for Bacteriological Purposes.) *Arb. a. d. k. Gesundheits-A.*, VIII. (1892) pp. 311–4.

Petri, R. J.—**Eine Flasche zur Sterilisation und zur keimfreien Entnahme von Flüssigkeiten.** (A Sterilization Flask, and means for obtaining Parts of Fluids free of Germs.) *Arb. a. d. k. Gesundheits-A.*, VIII. (1892) pp. 316–7.

(2) Preparing Objects.

Examination of Blood of Amphibia.*—Herr M. C. Dekhuyzen makes use of test-tubes with not too thin walls, holding 8 ccm., and having a diameter of 14 mm.; they are placed in a simple wooden stand, and filled with the fixation fluid or with simple salt solution. In the latter cases the tubes are filled first with water and boiled, and the slides are treated in the same way; the cover-glasses are cleaned with acetic acid, and water, and, after drying, with ether. The two fluids used were (*a*) (1) a 2 per cent. solution of osmic acid, (2) 6 per cent. acetic acid containing 24 per cent. of a watery solution of methylen-blue and a little (0·014 per cent.) acid fuchsin; (*b*) the other fluid contained 20 volumes of acetic acid mixed with 80 volumes of methylen-blue solution; 6 volumes of this fluid mixed with 14 volumes of a 1/5 per cent. solution of acid fuchsin gave the required concentration.

Before every fixation 2 ccm. of the last deep-blue mixture was well mixed with 6 ccm. of 2 per cent. osmic acid and placed in small tubes which were filled up to the top.

It is important to be very careful in allowing the blood when it comes from the blood-vessels to come into the most intimate contact with the fixing mixture. The blood-cells sink to the bottom. After thirty minutes a drop of the fluid should be placed on a stick, and then some of the bottom be drawn up and added to it; the cover-glass should be run round with xylol balsam. The preparations must be kept from the light.

Examination of Land Nemertines.†—Dr. A. Dendy, after various trials, finds that the best way of killing *Geonemertes australiensis* is first to hold the worm in vapour of chloroform for about half a minute, when the animal will contract to its normal resting condition and be rapidly stupefied. Then quickly plunge the worm into strong spirit. The creature is thus killed and hardened while under the influence of chloroform, and the proboscis is not ejected at all, nor does the body break up. If it is desired to kill specimens with the proboscis ejected they may be suddenly immersed in strong methylated spirit or in a cold saturated alcoholic solution of corrosive sublimate. The sections of the worm were stained with borax-carmine or Kleinenberg's hæmatoxylin; both methods should be employed, for the latter reagent brings out with wonderful distinctness the network of excretory tubules, which were not to be recognized in specimens treated with borax-carmine.

Killing Nematodes for the Microtome.‡—Mr. C. W. Stiles recommends the following method:—Only one worm can be killed at a time; place it on a large slide with a few drops of water, place a second slide

* Verhandl. Anat. Gesell., 1892, pp. 90–3.
† Proc. Roy. Soc. Victoria, 1891 (1892) pp. 89 and 90.
‡ Amer. Natural., xxvi. (1892) p. 972.

over the worm and move it slowly to and fro. This movement causes the worm to straighten. As soon as the Nematode assumes the desired position pipette in the fixing solution between the slides, continuing the motion of the upper slide till the worm is dead. By this method a specimen can be obtained which is perfectly straight and sound. Pressure on a delicate worm may be avoided by pasting a piece of paper on the upper surface of the second slide, and using that as a handle. As a killing liquid Mr. Stiles generally uses a solution of corrosive sublimate + 70 per cent. alcohol + a few drops of acetic acid heated to 50°; this passes through the cuticle very rapidly.

Methods of Studying Development of Amphiura squamata.*—Mr. E. W. MacBride fixed his specimens with corrosive sublimate in distilled or in sea water; with a mixture of three parts sublimate and one part acetic acid; with chromic, picric, and glacial acetic acid; with Flemming's solution, alcohol of 30 per cent., or alcohol (hot) at 70 per cent., with a few drops of corrosive; with one-fifth to 1 per cent. osmic acid; or with osmic acid followed by Müller's fluid for 18 to 20 hours. He found that the only liquid which gives reliable results is osmic acid, though there are certain disadvantages in its use, for it renders the animals very brittle and has little penetrating power. The shrinkage which follows its use is entirely prevented, and the brittleness is diminished if the osmic acid is followed by Müller's fluid. All liquids which decalcified as well as fixed were of no use as they gave rise to cavities by the evolution of gas in the still soft tissues. The method finally adopted by the author was to kill the animals in a solution of about half per cent. osmic acid allowed to act for ten minutes or so; after mixing with water they were transferred to Müller's fluid for 18 to 20 hours, then put at once into alcohol of 30 per cent. and brought slowly up into alcohol of 90 per cent. In this last they were hardened for a night; two or three drops of nitric acid were then added to some fresh alcohol of 90 per cent., and the animals were immersed in this till decalcification was complete, a process which occupied not more than twenty hours.

Double staining was used in order to be certain about the boundaries of sinuses, since the ordinary plasma of Echinoderms stains with great difficulty. Mayer's paracarmine was used as a nuclear stain; this has the great advantages that it acts rapidly, and that all superfluous stains can be extracted by 70 per cent. of alcohol, which can be allowed to act for an indefinite time. The plasma stained was applied on the slide; two were found to give good results—solution of picric acid in turpentine, and Mayer's oxidized hæmoglobin or "hæmatein." The advantage of the former is that it can be used with the shellac method of mounting without any danger of staining the mounting agent. For embryos preserved in glacial acetic acid Mayer's hæmalaun was used; this gives a blue nuclear stain and colours much of the plasma a faint yellow.

The embryos were imbedded in paraffin and cut into series of sections in a plane parallel to the line joining the madreporite with the mouth, and at the same time perpendicular to the plane of the disk. The specimens were always carefully oriented before being cut, a point

* Quart. Journ. Micr. Sci., xxxiv. (1892) pp. 131–4.

to which, in Mr. MacBride's opinion, Cuénot has not paid sufficient attention. Very thin sections—$3\frac{1}{4}$ μ, $4\frac{1}{2}$ μ, and for adults and oldest stages 7 μ—were made. The author states that he obtained perfect series of sections with finely differentiated stain, and clear, sharp outlines; the sections are said to be clearer and more diagrammatic than the figures he has been able to make of them.

Preparation of Larvæ of Asterias vulgaris.*—Mr. G. W. Field found that Kleinenberg's picric salt gave the most satisfactory results for killing these larvæ. Flemming's, followed by Merkel's fluid, gave excellent results, as did also Perenyi's fluid. Oil of cedar or of origanum proved most satisfactory for clearing.

Preserving Cunina.†—Dr. O. Maas killed the *Cunina*-stock and its buds with Flemming's chrom-osmic-acetic acid (5–20 minutes), gradually washed them with water, and passed them through a series of dilutions of alcohol up to 90 per cent. Thence some were replaced in water and stained with borax-carmine, but the unstained forms gave best results. Methyl-blue was also used to demonstrate the nervous system. The most important point is to see that the medusæ are properly placed before they are cut.

Preparing and Staining Yeast.‡—Dr. H. Moeller used for fixing yeast preparations a 1 per cent. solution of iodide of potassium saturated with iodine, this fluid ten times diluted, and also iodine-water. The material and the fixative may be mixed together at once or upon the cover-glass, which merely requires a smear. When fixed and dried the preparation must be thoroughly hardened. This may be done by leaving the preparations in the iodine solution for a day, and then after washing in water and weak spirit keeping them in absolute alcohol for one or two days. The time required for hardening may be diminished by repeatedly boiling the alcohol, and the preparations are more clearly stained if they are then immersed in chloroform for a day. It is always useful to pass the cover-glasses once or twice through the flame.

The preparations are best stained by means of hæmatein and picric acid, the latter acting as a mordant. But it is essential that the preparations should be thoroughly fixed and hardened; they may then be treated with a saturated aqueous solution of picric acid for 1/2–3 hours; the preparation is then passed through water so as to wash off some, but not all of the picric acid. For staining, an alkaline solution of hæmatoxylin is used. It would not appear, however, that the foregoing staining was more advantageous than that with anilins, of which the following were successfully employed:—phenolfuchsin, alkaline methylen-blue, Gram's method, and also gentian-violet in carbolic acid, water, glycerin, 1 per cent. acetic acid, and 1 per cent. iodide of potash.

If the anilin dyes are used the preparation should be over-stained and then differentiated by some decolorant; if Gram's method be adopted alcohol must be used; but for other stains a mixture of equal volumes of glycerin and water was found to give the best result. As soon as the desired degree of decolorization is attained the preparation

* Quart. Journ. Micr. Sci., xxxiv. (1892) p. 106.

† Zool. Jahrb., v. (1892) pp. 271–300 (2 pls.).

‡ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 537–50 (1 pl.).

is washed in water, dried in the air, and mounted in balsam, styrax, or dammar.

The grana or microsomes were best brought out by staining with some anilin dye and then differentiating with 2 per cent. acetic acid.

Spores are very easily stained by treating the preparation with boiling phenolfuchsin and then washing out in 4 per cent. sulphuric acid.

The yeasts used for these observations were natural cultivations of ordinary bottom yeasts. The yeast was shaken up with distilled water and then, after settling, the fluid decanted off. The sediment, after having been thus treated several times, was kept for the observations.

Method for Discovering Tubercle Bacilli in Milk with the Centrifuge.*—Herr Ilkewitsch says that he has successfully employed the following method for detecting tubercle bacilli in milk after these organisms had been precipitated by the centrifuge. The author was led to this procedure by finding that the intraperitoneal inoculation of guinea-pigs and rabbits was ofttimes unsuccessful. After the cream has been separated 20 ccm. of the milk are coagulated with citric acid. The residue separated from the whey by filtration is dissolved in an aqueous solution of sodic phosphate, treated with 6 ccm. of sulphuric ether, and then shaken up for 10 to 15 minutes.

The solution below the fat layer is drawn off by opening a tap at the bottom of the collecting vessel and then placed in the centrifuge. The sediment is separated from the fluid by means of a copper ball dropped into the separation-tube. This allows the fluid to be poured off and the sediment left behind. The sediment is then spread out on cover-glasses and obtained in the usual way.

(4) Staining and Injecting.

Method for Staining Tubercle Bacilli.†—Dr. B. A. van Ketel has devised the following procedure for detecting tubercle bacilli in sputum, &c. In a wide-mouthed flask capable of holding about 100 ccm., 10 ccm. of water and 6 ccm. of acid. carbolic. liquefactum are mixed. About 10–15 ccm. of the fluid to be examined are then added and the flask having been closed with a caoutchouc stopper is vigorously shaken for about a minute. With milk or very thin sputum the water may be omitted. After the shaking the fluid becomes milky; the flask is then filled up with water and again shaken. The fluid is then poured into a conical glass and allowed to subside. In from 12 to 24 hours some of the deepest lying sediment is removed with a pipette and spread on a cover-glass. The dried and heated cover-glass preparation is then washed in ether or chloroform and afterwards in alcohol, or the preparation may be treated with ether-alcohol. This is specially necessary if the preparation turn out rather thick. The cover-glass is then stained by the Ziehl-Neelsen method. The foregoing procedure is extremely simple, easily carried out, and produces a bright distinct microscopical picture.

* München. Med. Wochenschr., 1892, No. 5. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 441–2.

† Arch. f. Hygiene, xv. pp. 109–24. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 689–90.

Staining Solutions made with Carmine, Cochineal, and Hæmatin.* —Dr. P. Mayer, who has been at some pains to investigate the origin of cochineal and the composition of carmine, finds that carminic acid is not the sole staining principle, but that this acid must be considered in conjunction with alumina and also with calcium.

The practical outcome of his investigations and experiments are formulæ for staining solutions having a fixed composition and giving a definite result. Of these we may mention the following :—

Carmalum.—Carminic acid, 1 grm. ; alum, 10 grm. ; distilled water, 200 ccm. The solution is made with the aid of heat and the clear supernatant fluid or the filtrate used. The solution will keep if a few crystals of thymol be added, or if 1 per cent. salicylic acid or 5 per cent. salicylate of soda be used.

Paracarmin.—Carminic acid, 1 grm. ; chloride of aluminium, 1/2 grm. ; chloride of calcium, 4 grm. ; 70 per cent. alcohol, 100 ccm. The solution is made cold or by the aid of heat, and after having stood is filtered. There is no necessity to differentiate the stain with acidulated alcohol, although this may be done.

A staining solution made with cochineal, and having similar but less efficient properties to the foregoing:—Cochineal, 5 grm. ; chloride of calcium, 5 grm. ; chloride of aluminium, 0·5 grm. ; nitric acid (sp. gr. 1·20), 8 drops ; 50 per cent. alcohol, 100 ccm. The cochineal is to be finely powdered and mixed with the salts in a mortar. The spirit and acid are then added, and the mixture heated to boiling. It is allowed to stand for some days and filtered.

The author concludes by referring to hæmacalcium, a solution devised by him some time back.† He finds that it tends to throw down a deposit and decompose after a time, but this may be prevented by preparing the solution in two flasks, one containing the spirit, the acid, and the calcium chloride ; the other the hæmatin and the aluminium chloride. The two solutions are mixed when required for use.

Demonstrating Cholera Vibrio.‡—Dr. L. Heim gives the following as a very practicable procedure for demonstrating the presence of the cholera vibrio. From the evacuation or from the intestinal contents a flakelet of mucus should be taken, and having been spread out on a cover-glass, stained with fuchsin and examined with an oil-immersion for vibrios. At the same time another little flake of mucus is to be placed on a cover-glass, and a drop of bouillon added thereto. The cover is then fitted over a hollow-ground slide, and the margins vaselined to make a hanging drop cultivation. Two other particles are to be distributed, one in a test-tube filled with bouillon, the other in a test-tube containing gelatin. From the latter plate cultivations, after some attenuations, may be obtained. Even if the usual indispensable apparatus be wanting, the suspected material may be inoculated on bouillon or a 2 per cent. pepton solution, and a plate culture made from the gelatin solution, the latter serving for further inoculations. This procedure is to be repeated during the next 24 hours, during which the

* Mittheil. Zool. Station zu Neapel, x. (1892) pp. 480–504.

† See this Journal, 1891, p. 831.

‡ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 353.

bouillon tubes, together with the hanging drops intended for microscopical examination, are to be left. The latter should be protected from the light and kept in a warm place, best in an incubator. If the cholera germs have been in the excreta, they may be detected with a low power on the plates in 24–48 hours, and may then be inoculated in gelatin or pepton bouillon. In these the cholera-red reaction with sulphuric acid may be obtained the next day.

In default of the double capsule, a couple of dinner plates or saucers, the undermost being covered with blotting-paper, will serve the purpose of making a moist chamber. The incubator may be replaced by a pot or saucepan partly filled with water at 30°–27°. In this the test-tube, &c., may be incubated by fixing them in beakers laden with sand to keep them steady. The saucepan is covered with its lid, and a temperature approximate to that of the body is maintained by means of a night-light placed under the pot.

Staining Flagella of the Tetanus Bacillus.*—As a rule, says Dr. R. Schwarz, the tetanus bacillus has a flagellum at one of its rounded ends, and this is usually somewhat, occasionally considerably, larger than the bacillus itself. In sporogenous bacilli the flagella cannot be perceived. The flagella were best stained by Loeffler's method on bacilli taken from bouillon cultivations developed under hydrogen, and 48 hours old. Two drops of 1 per cent. soda solution were added to the mordant. Trenkmann's method was not successful.

Staining Flagella of Bacteria.†—Herr L. Luksch finds that by substituting ferric acetate for the sulphate of iron in the mordant devised by Loeffler for staining bacterial flagella, the disagreeable deposit on the surface of the preparation is obviated. It is certainly true that this deposit renders the original procedure ‡ less effective in practice than the promise held out, and it is noted by the author that Loeffler's solution should be made with the ferric, and not with the ferrous salt, but if the acetate gets rid of the surface deposit the distinction may be neglected.

The author's solution is made from freshly prepared cold saturated ferric acetate; in other respects the formula is the same as Loeffler's, except that to the 16 ccm. of the mordant, 5–10 drops of acetic acid are added.

When the preparation has been slightly warmed for one minute it is washed in water and then in 20 per cent. acetic acid to give greater clearness. It is again washed in water several times, after which it is warm-stained with anilin-water-fuchsin or anilin-water-gentian-violet.

Examining Sputum in Sections.§ — When examining sputum in cover-glass preparations many of the delicate and fragile cells, says Dr. Gabritschewsky, are destroyed, but this may be avoided by making sections of sputum which has been fixed and hardened. For this purpose alcohol, Flemming's fluid, chromacetic acid, picric acid and saturated sub-

* Lo Sperimentale, 1891, p. 373. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 391. † Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 430.

‡ See this Journal, 1890, p. 678.

§ Deutsch. Med. Wochenschr., 1891, No. 43. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 395.

limate solution are well suited. Müller's fluid cannot be used as it softens and disintegrates the masses of expectoration.

The staining solutions employed by the author were alum-carmine, safranin, and hæmatoxylin-eosin. By this method in three cases out of four examined, giant cells were demonstrated.

Rapid Staining of Tubercle Bacilli in Tissue preserved in Müller's Fluid.*—M. Letulle gives the following procedure for staining tubercle bacilli in tissues which have been hardened in Müller's fluid. According to this, and indeed other writers, Müller's fluid is unsuitable as a hardening agent when these micro-organisms are to be sought for.

After hardening in Müller's fluid the material is treated with spirit and then imbedded in celloidin. The sections are then stained with hæmatoxylin and next with a rubin solution (2 per cent. carbolic acid water with rubin to saturation). The sections, after having been washed with water and alcohol, are further stained with iodine-green (iodine-green 1 grm., 2 per cent. carbolic acid water 100 grm). The preparations are then mounted in the usual way.

The nuclei are stained violet, hyaline bodies rose, and the bacilli dark red, the rest remaining white. The whole procedure lasts barely half an hour.

Hofmeister, F.—**Ein Apparat für Massenfärbung von Deckglastrockenpräparaten.** (Apparatus for Staining dry Cover-glass Preparations.)
Fortschr. d. Med., 1892, pp. 531–6.

(5) Mounting, including Slides, Preservative Fluids, &c.

Preserving Fluid and Fixing Material.†—Dr. F. Krasser recommends as a preserving fluid for vegetable substances a mixture of 1 vol. acetic acid, 3 vols. glycerin, and 10 vols. of a 50 per cent. solution of sodium chloride. In this solution sections of beet and of etiolated potato-shoots retained their structure and their colour for nearly a year.

Salicyl-aldehyde is a good fixing material for chromatophores, as e.g. the pigment of *Solanum Lycopersicum*. For this purpose Dr. Krasser uses a 1 per cent. alcoholic solution.

Glycerin Mounting.‡—Dr. C. E. McClung recommends the use of glycerin in the following:—"The use of glycerin as a mounting medium is not as universal as its qualities merit it should be. The convenience with which a balsam mount is made proves a temptation which many microscopists cannot resist, and as a result, numerous mounts are entirely spoiled by consigning the object to a medium not adapted for its reception. There is a fitness in all things, and the saying is as applicable to microscopy as to other departments of work. Balsam has its use and glycerin its application, and the two should be confined to their respective provinces. Frey says, 'What balsam is to dry tissues, glycerin is to moist ones,' and the saying might be made even more emphatic.

Glycerin has the advantage of being non-volatile, colourless, slightly

* Gazette Hebd., 1892, No. 22. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 441.

† SB. K. K. Zool.-Bot. Gesell. Wien, May 20, 1892.

‡ The Microscope, xii. (1892) pp. 201–3.

affected by changes of temperature and of having a high refractive index. An advantage of special importance is that it remains perfectly colourless for any length of time, while balsam, in a few years at most, becomes yellow, and finally so opaque that the preparation is worthless. The soft, natural appearance which objects mounted in glycerin have renders any extra labour incurred in their preparation a matter of little moment to the artistic manipulator.

The difficulty experienced in the manipulation of glycerin deters many from its more frequent employment. If attention is paid to details, however, it will be found but little more difficult to use than balsamic mediums. In order to bring out the points of importance, a brief description of the preparation of an ideal mount will be expedient. Attention is first directed to the material and apparatus used.

The glycerin should be pure, and free from dust and air-bubbles. To keep it free from these contaminations, devices such as are recommended by Carpenter and Prof. James are excellent. These are bottles containing the glycerin, and provided with glass tubes, whereby the glycerin is forced out by air-pressure.

The cements may be of a balsamic nature, but preferably zinc oxide or asphalt. Any cement not affected by the medium may be employed, but experience has proven that the two above named are the best.

The other essential parts of the completed mount are the slip and cover-glass. No special mention is required concerning these except that they should be perfectly clean. To ensure this, the practice of leaving them until ready for use in a bath of ordinary battery fluid is recommended.

In preparing a mount, the operations naturally divide themselves into four divisions, coming under the heads—(1) preparing the cell; (2) preparing the section; (3) placing section in the cell; and (4) securing the cover-glass to the cell.

Under the first head attention is called to three points, viz. thickness of the cement, depth of cell, and age of the cell. Upon the consistency of the cement depends in a great measure the formation of a good cell. It should not be thin enough to spread, yet should flow readily and smoothly from the brush. The depth of the cell should be such that a complete support shall be provided for the cover-glass without causing it to bear upon the object when cemented down, and yet should not be of such a depth as to interpose an unnecessary stratum of glycerin between the section and cover-glass.

Of more importance, perhaps, than any other point, is the direction regarding the age of the cell. It is a common practice to ring a cell and use it while fresh, the manipulator arguing that a more perfect union of cell-wall and cover-glass is secured in this manner. Perhaps this is true, but it is at the expense of the slide's usefulness. An author already quoted is authority for the statement that an ordinary balsam cell will, in drying, shrink 30 per cent.

Under these conditions and in view of the fact that glycerin is non-compressible, something must give way when the cell contracts; and this is either the cover-glass or cell-wall. Whichever it is, the final result is the destruction of the mount and loss of all the work involved in its preparation. This leads us then to make the following statement:

—Never use a 'green' cell. The older the cell the better, and, at ordinary temperatures, two weeks is the shortest space of time in which a cell of medium depth will become seasoned.

Assuming the mount to be a section of vegetable tissue, the steps involved in its preparation would be the cutting, staining, washing, and dehydrating. The length of this article will not permit any reference to cutting, so the process of staining is next noticed. Any stain insoluble in the glycerin may be used. It is best applied immediately after the cutting of the section. After the section has acquired the proper depth of colour, it should be thoroughly washed, and then placed in glycerin. From here it goes through the next process—placing in the cell. In placing the section care should be exercised to have it exactly in the centre of the cell. With the section thus situated a drop of glycerin is allowed to fall upon it from the dropping-bottle. Take the clean cover-glass between the left thumb and forefinger, and place the left side in contact with the drop of glycerin; draw it over until supported on the left edge of the cell-wall; loose the hold of the left hand and allow the cover-glass to fall gradually by supporting the right edge with a needle. Having thus placed the cover-glass and centered it, place a clip upon it. The superfluous glycerin thus forced out is washed away by means of a jet of water from the wash-bottle so directed as not to strike under the cover-glass. Some water does get under, but this does no harm, as it supplies moisture which the glycerin otherwise would have by 'creeping' from the cell.

When thoroughly dried by means of strips of bibulous paper the slide is ready for the last step—securing the union of cover-glass and cell-wall. This result is best obtained by ringing once around the cover-glass and allowing this coat to dry before applying cement enough to hide the junction of the cover-glass and cell-wall. When this latter step is accomplished the mount is essentially complete, but no one who has a pride in his work will leave the slide unstriped. There is no more beautiful slide than one formed of white cement and ringed with black. Properly labelled and cleaned, the slide is ready for the cabinet; and if the due amount of care has been exercised in its preparation, it will always be a source of pride and pleasure to its owner."

An Aqueous Solution of Hæmatoxylin which does not readily deteriorate.*—Prof. S. H. Gage writes as follows:—"For most of the purposes of histology there is no more satisfactory and generally applicable stain than hæmatoxylin; and experience has shown that aqueous solutions are on the whole preferable to those containing a considerable quantity of alcohol. Every microscopist knows, however, that aqueous solutions of hæmatoxylin soon begin to deposit a dark precipitate on the bottle and become filled with granules, and frequently with threads or fungus mycelium.

As so many chemical changes are due to living ferments, bacteria, fungi, &c., it occurred to the writer that the deterioration of the hæmatoxylin might be due to some living ferment or ferments, and if these could be eliminated the solution would retain its excellence. Experiment proved the correctness of this supposition, for an aqueous hæma-

* Microscopical Bulletin and Sci. News, ix. (1892) pp. 36 and 7.

toxylin, prepared as directed below, made in February of the present year, is at present writing, after eight months, as good as when first made. During the eight months it has remained in the laboratory, and has been subjected to all the vicissitudes of heat, dust, &c., that an ordinary histological reagent must endure. The bottle has no deposit upon it, and the solution is entirely devoid of the spores or mycelium of fungi, and is in fact as good as when first made. Formula :—Distilled water, 300 ccm.; potash alum, 10 grm.; chloral hydrate, 6 grm.; hæmatoxylin crystals, 1/10 grm.

To prepare the solution, place the water in an agate or porcelain dish and add the alum either in powder or small pieces. Boil the water and alum for five minutes. When cool add the chloral hydrate and the hæmatoxylin. It is advantageous to dissolve the hæmatoxylin in 5 to 10 ccm. of absolute or 95 per cent. alcohol before adding to the alum solution.

The colour will be quite light at first, but in a week or two it will be of a dark purple. The boiling is to destroy all living objects in the water or alum, and the chloral hydrate is to prevent the development of germs that accidentally reach the solution after its preparation. The solution may be made more concentrated by adding hæmatoxylin. For slight dilution, distilled water will answer, but the mixture of alum, chloral, and water is the best diluent."

PROCEEDINGS OF THE SOCIETY.

The Conversazione.

The following is the list of objects exhibited at the Conversazione held on November 30th, 1892, in the Banqueting Saloon, St. James's Hall Restaurant:—

Mr. T. D. Aldous:—Photographs of old Microscopes.

Mr. J. M. Allen:—Rotifera, viz. *Brachionus pala*, *Euchlanis lyra*, *Noteus quadricornis*, and *Polyarthra* sp.

Mr. F. W. Andrews:—Section of Fossil Coral; Section of Garden Pea; *Melicerta ringens*.

Rev. G. Bailey:—Foraminifera.

Mr. E. E. Branham:—Pond-life.

Mr. E. Bartlett:—*Vorticella* sp., from the Serpentine.

Mr. W. E. Baxter:—*Aulacodiscus dispersus* × 600.

Messrs. R. and J. Beck:—*Amphipleura pellucida;* Scales of Podura (*Lepidocyrtus curvicollis*); Leaf of *Vallisneria*, showing circulation of sap; *Bacillus tuberculosis* in sputum.—All the foregoing objects shown under a 1/12 Oil-immersion Objective.

Mr. J. B. Bessell:—Photomicrographs of Diatoms taken by Mr. W. E. Brown.

Mr. W. A. Bevington:—Head of Spider.

Mr. E. T. Browne:—*Sarcodictyon catenata*, from Port Erin, Isle of Man.

Mr. J. Browning:—Microscopes and Spectroscopes.

Mr. W. Burton:—*Lophopus crystallinus* and Rotifers.

Mr. F. Chapman:—Foraminifera from the Gault of Folkestone.

Mr. W. J. Chapman:—Pond-life.

Mr. H. G. Coombs:—Spines of Echinus.

Mr. T. Curties: *Licmophora*; Spines of Echinus.

Mr. E. Dadswell:—Pond-life.

Mr. F. Enock:—Heads of Insects.

Mr. F. W. Ersser:—Circulation of the Blood in the Foot of a Frog.

Mr. F. Fitch:—Mouth of *Bibio* sp.; Mouth of Saw-fly; Mesosternum of Blow-fly.

Mr. T. E. Freshwater:—Bees and Bee Culture.

Mr. J. W. Gifford:—Gland in Tongue of Kitten, preparation fixed by injection with osmio-aceto-chromic solution, stained logwood and safranin; Kidney of Kitten, preparation fixed by injection with chromic acid, stained logwood.

Mr. C. H. Gill:—Pure Cultivation of a Species of *Nitzschia; Pleurosigma attenuatum* invaded by a Parasitic Fungus; Photomicrographs of Diatoms.

Captain C. E. Gladstone, R.N.:—Transverse Section of Leaf-bud of Sycamore.

Mr. H. Groves:—*Batrachospermum atrum; Nitella opaca*, showing cyclosis.

Mr. J. Hart:—Flower and Leaf-buds; Textile Fabrics and Sections of Cotton; Sections and Photomicrographs of the Spines of Echinus.

Mr. F. W. Hembry:—*Ætea anguina* (*Anguinaria spatulata*).

Mr. J. E. Ingpen:—Specimens illustrating Dr. Hodgkinson's method of examining Iridescent Bodies.

Messrs. Johnson & Son:—*Synapta* sp. from New Zealand; *Distomum* sp.; Section of Kidney; Stand of Microscope by Varley, about 1812.

Mr. G. C. Karop:—Arachnoidisci *in situ;* Chromatoscope and Condenser.

Mr. T. Lambert:—Indian Tortoise Beetle.

Mr. R. Macer:—A Living House-fly (*Musca domestica*), showing head, antennæ, compound eyes and proboscis.

Mr. G. E. Mainland:—Fibro-cells from Orchid; *Polyxenes lagurus.*

Mr. C. C. Muiron:—*Lophopus crystallinus; Melicerta ringens; Spongilla fluviatilis; Stephanoceros Eichhornii.*

Mr. J. H. Mummery:—Blood Preparations (Prof. Ehrlich's film preparation); An eosinophilous Leucocyte.

Messrs. E. M. Nelson and C. L. Curties:—Resolution of *Navicula rhomboides* by 1/2-in. Apochromatic and Monochromatic Light × 570.

A new Spherometer.

Diagrams showing the Chromatic Curves of Displacement of the images by various lenses at their conjugate foci.

Jubilee Microscope fixed to Lamp-stand, showing conjugation of *Spirogyra;* the Microscope had also a separate stand and a handle for use in the field, designed 1887.

Projection Instrument for drawing with low powers, 16–30 diameters.

Mr. J. M. Offord:—Diatoms from Bori; Tongue of Blow-fly.

Col. R. O'Hara:—Jaw of Cobra, showing Poison-fang *in situ;* Fangs of Cobra, showing construction, and poison channel; Dental Bulb of *Oxyuris curvula.*

Mr. F. Oxley:—*Conochilus volvox.*

Mr. F. A. Parsons:—*Doto coronata; Eolis coronata.*

Messrs. Powell & Lealand:—Circulation in *Vallisneria* with 1/4 in. Apochromatic and Apochromatic Condenser.

Mr. B. W. Priest:—*Spongilla iglooiformis*, showing Statoblasts, Pennsylvania.

Mr. F. Reeve:—Fern Spores (*Davallia* sp.).

Dr. H. B. Robinson:—Human Hairs in their Sheaths, longitudinal and transverse sections.

Mr. C. Rousselet:—A tank showing Pond-life in Winter; Rotifera.

Sir David L. Salomons:—Dick's Petrological Microscope, with improvements, exhibited by Messrs. Swift.

Mr. G. C. Seligman:—Section of Wart.

Mr. W. Smart:—Proboscis of *Echinorhyncus* sp. from Freshwater Trout; Unexpanded Wing of Tortoise-shell Butterfly.

Mr. Alpheus Smith:—Pond-life.

Mr. G. F. Smith:—Petrological Slides.

Mr. T. F. Smith:—Diatoms.
Rev. G. Southall:—Photomicrographs.
Mr. A. T. Spriggs:—Ferns (*Osmunda regalis* and Hare's Foot).
Mr. A. W. Stokes:—Scales of Ferns, polarized; Acetate of Copper, polarized; Tissue-paper, polarized.
Mr. W. T. Suffolk:—Mouth of Blow-fly.
Messrs. Swift & Sons:—Dick's Petrological Microscopes; Aluminium Microscope: Paragon and Challenge Microscopes; Topaz; Mica; Hyposulphate of Soda; *Daphnia; Melicerta; Hydra;* and *Bacillus tuberculosis.*
Mr. J. Terry:—Pond-life.
Mr. J. J. Vezey:—Lung of Frog injected.
Mr. H. J. Waddington:—*Campanulina acuminata; Medusa; Asterina gibbosa; Caprella; Pycnogonum; Nymphon; Cirratulus; Bowerbankia; Pedicellina; Tubularia;* Young Molluscs; *Eolis; Shepherdella*; and Rotifera.
Messrs. W. Watson & Sons:—Edinburgh Students' Microscopes; Group of Eggs of Butterflies, Moths, &c.; Scales of Insects arranged as a Vase of Flowers; Echinococcus from Brain of Sheep; Group of Diatoms from Bori, Hungary; Group composed of Diatoms, &c.; Hydrozoon (*Coryne fruticosa*); Lip of Cat, showing Sensory Hairs; Bacillus of Cholera; Bacillus of Tetanus.
Mr. W. West:—Liver of Hedgehog, injected; Spore of Fern (*Davallia*).
Mr. G. Western:—*Conochilus volvox* and other Rotifera.
Mr. T. C. White:—Comb and Brush of House Ant.
Mr. R. D. Wickes:—Eyes of Hunting Spider (*Salticus tardigradus*).
Mr. J. Willson:—A Miniature Volcano—Platinocyanide of Strontium, polarized; Hymenoptera from Ceylon.

MEETING OF DECEMBER 21ST, 1892, AT 20, HANOVER SQUARE, W., THE PRESIDENT (DR. R. BRAITHWAITE, F.L.S.) IN THE CHAIR.

The Minutes of the meeting of 16th November 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
The Microscope. By Dr. H. Van Heurck. English edition by W. E. Baxter. 400 pp., 3 pls., text illust. (8vo, London, 1893)	*Mr. Wynne E. Baxter.*
Nuove Osservazioni microscopiche del P. D. G. M. della Torre. 136 pp., 14 pls., text illust. (4to, Napoli, 1776)	*Mr. Frank Crisp.*
A Manual of Bacteriology. By Dr. G. M. Sternberg. (8vo, New York, 1892)	*The Author.*
I Funghi più dannosi alle Piante coltivate. Del P. Voglino. Pts. 1-8	*The Author.*

The President said there were two matters which he wished to mention at that meeting. The first was with reference to their recent Conversazione, which he thought every one would agree was a great success, and on behalf of the Council he wished to take that opportunity of thanking all those who had helped to make it so. Everything which he saw on that occasion was beautifully exhibited, and those who were present appeared to thoroughly appreciate the objects shown. It reminded him of some of the gatherings they used to have in the early days of the Society, and he hoped they would on some future occasion be able to carry out a similar meeting with equal success. The other matter to which he desired to refer was the death of Sir Richard Owen, The newspapers had no doubt made them acquainted with the fact, but perhaps it might not be known to the younger Fellows of the Society that he was their first President, having been elected in 1840, or fifty-two years ago. Though on account of his advanced age and infirmity it was long since they saw him amongst them, he was, no doubt, very well known to every one by his writings, his books on 'Odontography' and 'Vertebrate Anatomy' having had a wide circulation. Many years ago, when he (the President) was an apprentice, Owen's lectures on Comparative Anatomy were appearing in the 'Lancet,' and he used to make them his great study at the time. The loss was to him—perhaps more than to many present that evening—a personal one; but as Sir Richard Owen had been so intimately associated with their Society as its first President, they had decided, after passing a resolution of condolence, to adjourn the meeting out of respect to his memory. No papers would therefore be read that evening, but after the transaction of such business as was actually necessary, the sitting would be suspended.

The following resolution, drawn up by the Council, was then submitted to the meeting, and unanimously adopted :—

> "The President, Council, and Fellows of the Royal Micro-
> "scopical Society, having heard with sincere regret of the death
> "of Sir Richard Owen, the first President of the Society, desire
> "to record their sincere condolence with his family, and their
> "appreciation of the great loss which science has sustained by
> "the removal of one whose world-wide attainments had placed
> "him at its head."

The President announced that their next meeting, on January 18th, 1893, would be the Annual Meeting of the Society, in preparation for which it would be necessary that evening to read the list of Fellows nominated by the Council for election as Officers and Council for the ensuing year. The Fellows present would also be asked to elect an Auditor for the Society's accounts for the current year.

The following List of Nominations was then read :—

President—Albert D. Michael, Esq., F.L.S.

Vice-Presidents — Prof. Charles Stewart, Pres. L.S.; Robert Braithwaite, Esq., M.D., M.R.C.S.; Frank Crisp, Esq., LL.B., B.A., V.P. and Treas. L.S.; and James Glaisher, Esq., F.R.S., F.R.A.S.

Treasurer—William Thomas Suffolk, Esq.

Secretaries—Prof. F. Jeffrey Bell, M.A., and Rev. W. H. Dallinger, LLD., F.R.S.

Twelve other Members of the Council—Lionel S. Beale, Esq., M.B., F.R.C.P., F.R.S.; Alfred W. Bennett, Esq., M.A., B.Sc., V.P.L.S.; Rev. Edmund Carr, M.A., F.R.Met.S.; Edward Dadswell, Esq.; Charles Haughton Gill, Esq., F.C.S.; Richard G. Hebb, Esq., M.A., M.D., F.R.C.P.; George C. Karop, Esq., M.R.C.S.; Edward Milles Nelson, Esq.; Thomas H. Powell, Esq.; Prof. Urban Pritchard, M.D.; Frederic H. Ward, Esq., M.R.C.S.; Thomas Charters White, Esq., M.R.C.S., L.D.S.

The President said that two Auditors of the accounts would have to be appointed that evening, and on behalf of the Council he nominated Mr. W. T. Suffolk to that office.

Mr. J. M. Allen was then duly appointed Auditor on behalf of the Fellows of the Society, upon the nomination of the Rev. Canon Carr, seconded by Mr. J. J. Vesey.

The meeting was then adjourned.

New Fellows :—Dr. Algernon S. Barnes, Jr., Messrs. Joseph Blundell and James William Gifford, and Prof. Frank S. Johnson.

Annual Meeting, held 18th January, 1893, at 20, Hanover Square, the President (Dr. R. Braithwaite, F.L.S.) in the Chair.

The Minutes of the Meeting of 21st December 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 were given to the Donors.

	From
Reports of the Birmingham Natural History and Microscopical Society. (8vo, Birmingham, 1866-91)	*The Society.*
The Aquarian Naturalist. By T. Rymer Jones. xx. and 480 pp., 8 pls. (8vo, London, 1858)	*Mr. W. T. Suffolk.*

Prof. F. Jeffrey Bell read to the meeting a letter which the Council had received from the Rev. Richard Owen, acknowledging the receipt of the vote of condolence passed at the last meeting of the Society with reference to the death of the late Sir Richard Owen, their first President.

Prof. Bell also read a letter addressed to the Council by Sir Henry Trueman Wood, Secretary of the Royal Commission for the Chicago Exhibition, asking if the Society would be inclined to lend a collection of photomicrographs for the forthcoming Exhibition at Chicago. As it was stated that they must be sent in before the end of the present month, the Council felt it would be impossible for them to deal with the matter properly in the time at disposal, but if any of the Fellows

would like to send specimens they might be able to send them in the course of next week direct to Sir H. Trueman Wood.

Mr. Frank Crisp asked whether they were not to be sent in the first instance to the Committee to be examined? He thought that the general feeling at the Council meeting was that this should be done.

Prof. Bell said it was suggested, but no committee was appointed because there seemed to be no time for it to act.

Mr. J. E. Ingpen thought if exhibits of this kind were to be sent in by individual Fellows they could not go to the Exhibition as being sent by the Society.

The President said it would be most desirable that whatever went from the Society should be essentially good in quality, because to some extent their reputation would be at stake in the matter.

Mr. Crisp thought this made some kind of selection necessary, even if it was only done by a committee of one.

It was thereupon agreed, at the suggestion of Prof. Bell, that if any Fellows desired to exhibit photographs in connection with the Society they should send them in at once to the office to be forwarded for the purpose.

The President having appointed Messrs. J. M. Allen and G. Western to act as Scrutineers, the ballot for the election of Officers and Council for the ensuing year was proceeded with.

Prof. Bell said they had received a letter from the Manchester Microscopical Society stating that they had decided to hold a conversazione on January 21st, and asking any Fellows of the Society to be present as exhibitors. The invitation, he was afraid, came almost too late to be generally accepted, but he would place it upon the table so that if any one felt inclined to go down to Manchester on Saturday with his instrument he would know whom to address on the matter.

The President, on rising to deliver the Annual Address, said that he had not yet written anything upon the subject which he intended to bring before them, but proposed on that occasion to continue, in a conversational way, the topic upon which he addressed them last year, namely "The Development of the Spores in Ferns and Bryophyta." Last year he had traced the process of reproduction as far as the archegonia and antheridia, and he now proposed to speak upon the further development, more especially with regard to the Mosses and Sphagnums. By means of drawings upon the blackboard the structure and growth of the cells, stem, leaves, and inflorescence were then popularly explained, and a number of slides exhibited under Microscopes in the room were referred to in further illustration of the subject.

The Rev. Canon Carr said he had much pleasure in moving a hearty vote of thanks to the President for the very lucid and interesting address which he had just given, and he thought it a great advantage to those who were not conversant with the subject to have it brought before them in that way by means of blackboard drawings, instead of having it read

as a formal address. They were also afforded the further advantage of seeing for themselves under the Microscopes on the table many of the points of interest which had been described.

Mr. W. T. Suffolk having seconded the motion, it was put to the meeting and carried unanimously.

The President was much obliged for this expression of their good will. He feared that he had on the whole been rather a poor President, especially so far as his addresses were concerned, the great pressure upon his time making it almost impossible to do what he could have desired in the matter.

Prof. Bell then read the Report of the Council for the past year as follows:—

REPORT OF THE COUNCIL FOR 1892.

Fellows.—During the year 1892, 32 new Fellows were elected, whilst 20 have died and 36 have resigned. Among the deaths the Council note with regret that of the first President of the Society—the veteran Sir Richard Owen, K.C.B., F.R.S. The considerable increase in the number of resignations may be explained by the Treasurer's efforts to obtain subscriptions due to the Society from Fellows who are no longer interested in it.

The List of Fellows now contains the names of 622 Ordinary, 1 Corresponding, 50 Honorary, and 86 Ex-officio; or a total of 759.

Finances.—Notwithstanding that the numerous deaths and resignations have exceeded those of previous years, the Council are glad to report that the annual income from subscriptions is slightly above the average of the last five years.

The Council note with satisfaction that the sale of the Journal is still increasing, the amount received from their publishers showing an increase of 37*l.* 6*s.* over that of last year.

Rooms.—The negociations with the Society's landlords having been concluded, the rooms have been (as was promised in last year's Report) opened for the use of Fellows on every Wednesday evening from November to June, and the Council are pleased to notice that the Fellows have expressed satisfaction with this arrangement.

Library.—The addition of six new bookcases has greatly relieved the hitherto congested state of the Library, and allowed of the completion of the re-arrangement of the books. The Council have to report that a new Catalogue of the Library is being prepared, which will further increase the usefulness of the Library to the Fellows.

Journal.—Save the proof afforded by the money returns, there is nothing special to report with regard to the Journal of last year. The Council have with great reluctance been compelled to raise the price of the Journal to non-Fellows from 5*s.* to 6*s.* per number, but this step has been forced on them by the higher rate at which printers are now paid.

The Transactions, on which, as before, the Council feel that the reputation of the Society as a scientific body largely depends, contain

this year 12 communications, as against 11 last year, and are illustrated by 12 as against 10 plates. More papers would have been communicated had not two meetings during the past year been *dies non*, for the meeting of January was adjourned as a mark of respect to the funeral of H.R.H. the late Duke of Clarence, eldest son of H.R.H. our Patron; and the December meeting was similarly adjourned as a sign of the regret which the Society felt at the death a few days previously of Sir Richard Owen, its first President.

Conversazione.—The Council are happy to report that the change in the form of the Conversazione appears to have met with the approbation of the Fellows and their friends. The Conversazione was held on November 30th, and passed off very successfully, and to the satisfaction of those who attended. There were 68 exhibitors and about 321 visitors. The Council have to express their best thanks to all who assisted at the meeting, and especially are they grateful for the liberal supply of lamps, for which they are indebted to the kindness of Messrs. Baker.

Treasurer.—It is with great regret that the Council have to announce to the Fellows that the many calls on the time of the present Treasurer make it imperative for him to resign his post. It is now nineteen years since Mr. Crisp was first associated with the Society as one of its officers, and it has been during these years that the Society has increased so much in numbers and in public estimation. If the Society will, as it assuredly will, elect him as one of its Vice-Presidents, it will still have the great benefit of his advice and experience; but the Council, as the spokesman of the Society, is bound to give especial prominence to a grateful recognition of the many services of many kinds which Mr. Crisp has rendered it. It is a source of satisfaction to the Council that it has been able to find a Fellow, well known to the attendants at the meetings, fully conversant with the affairs of the Society, and of high position in the City of London, who is willing to offer himself for election in place of Mr. Crisp.

The adoption of the Report having been moved by Mr. G. C. Karop, and seconded by Mr. J. M. Allen, was put to the meeting by the President and carried unanimously.

The Treasurer (Mr. Frank Crisp) then read the Annual Statement of Accounts and submitted the Balance-sheet for the year 1892, duly audited by Messrs. J. M. Allen and W. T. Suffolk, who were appointed for the purpose at the preceding meeting.

Mr. A. D. Michael said he rose to move the adoption of the Treasurer's Report and Balance-sheet, but felt that he could not do so without expressing his sense of the extreme debt of gratitude which they owed to Mr. Crisp for his services to the Society, not only during the past year, but also during so many years which preceded it, services which had been so admirably performed, and had tended so greatly to the benefit of the Society.

Mr. J. J. Vezey having seconded the motion, it was put from the chair, and carried by acclamation.

Dr. THE TREASURER'S ACCOUNT FOR 1892. Cr.

1892.	£	s.	d.
To Balance brought from 31st December, 1891	98	17	5
„ Interest on Investments	81	6	8
„ Admission Fees	60	18	0
„ Annual Subscriptions	856	5	1
„ Composition	31	10	0
„ Sale of Journal	361	12	4
„ Advertisements	32	15	2
„ Catalogues sold	0	5	8
„ Woodcuts sold	3	1	9
„ Tools sold	0	12	0
„ Reprints	3	3	9
	£1530	7	10

1892.	£	s.	d.
By Rent, Coals, and Attendance	133	14	0
„ Salaries, Reporting, and Commission	134	3	9
„ Books and Binding	92	9	1
„ Bookcases	11	15	0
„ Expenses of Journal	874	14	6
„ Postage of Journal	34	6	9
„ Reprints of Papers	5	9	0
„ Bye-Laws and List of Fellows, 1892	20	12	6
„ Stationery and Miscellaneous Printing	29	1	3
„ Refreshments at Evening Meetings	11	14	6
„ Conversazione	25	5	0
„ Abbe Condensers and Lamp	8	8	6
„ Fire Insurance	1	10	0
„ Petty Cash	38	10	3
	£1421	14	1
„ Balance remaining 31st December, 1892	108	13	9
	£1530	7	10

FRANK CRISP, *Treasurer.*

Investments, 31*st December*, 1892.

1200*l.* Freehold Mortgages. 780*l.* 17*s.* 3*d.* India Three per Cents. (including 100*l.* Quekett Memorial Fund).

The foregoing Annual Account examined and found correct, 4th January, 1893.

W. T. SUFFOLK,
J. MASON ALLEN, } *Auditors.*

The President then announced that the Scrutineers had reported that the whole of the gentlemen whose names were printed on the ballot paper had been elected as Officers and Council of the Society for the ensuing year, as under:—

President—*Albert D. Michael, Esq., F.L.S.

Vice-Presidents—*Robert Braithwaite, Esq., M.D., M.R.C.S., V.P.L.S.; *Frank Crisp, Esq., LL.B., B.A., V.P. and Treas. L.S.; *James Glaisher, Esq., F.R.S., F.R.A.S.; *Prof. Charles Stewart, Pres. L.S.

Treasurer—*William Thomas Suffolk, Esq.

Secretaries—Prof. F. Jeffrey Bell, M.A.; Rev. W. H. Dallinger, LL.D., F.R.S.

Twelve other Members of the Council—Lionel S. Beale, Esq., M.B., F.R.C.P., F.R.S.; *Alfred W. Bennett, Esq., M.A., B.Sc., V.P.L.S.; Rev. Edmund Carr, M.A., F.R.Met.S.; *Edward Dadswell, Esq.; *Charles Haughton Gill, Esq., F.C.S.; Richard G. Hebb, Esq., M.A., M.D., F.R.C.P.; *George C. Karop, Esq., M.R.C.S.; Edward Milles Nelson, Esq.; Thomas H. Powell, Esq.; Prof. Urban Pritchard, M.D.; Frederic H. Ward, Esq., M.R.C.S.; Thomas Charters White, Esq., M.R.C.S., L.D.S.

Dr. Braithwaite then vacated the chair and installed as President of the Society for 1893, Mr. A. D. Michael, F.L.S., whom he humorously characterized as a "mitey" man from whom mighty deeds would be expected.

Mr. Michael said that it was not altogether a pleasant process to dispossess his predecessor, but when a person was introduced to a Society like that as its President it certainly became his duty to return thanks to those by whom he had been elected. But so far as the custom was concerned it was not one which exactly commended itself to his judgment, because, in making a selection, the Council were in the first place bound to consider the benefit of the Society and not that of the individual; but in spite of this objection he was, on that occasion, going to follow the usual course, because he found it impossible altogether to eliminate the personal element from his own mind. He could not help feeling that when a body of gentlemen with whom he had worked for so many years, so pleasantly and so usefully as had been the case during his connection with their Society, had elected him to a position of the greatest honour which they could confer, it would be unpleasant to take the chair without any word of thanks; therefore he returned them most heartily his thanks for the honour conferred. In one way, however, he hoped that the personal element would be expressed, and that was that by the united efforts of themselves and their friends the period of his presidency might be rendered one of active scientific work which should be equal to the best work of the past, and not unworthy of what they hoped yet to do in the future.

The President said it now only remained for him to put to the meeting a proposal which had been duly moved and seconded, but not

* Those with an asterisk (*) have not held during the preceding year the office for which they were nominated.

yet voted upon, namely, "That the best thanks of the Society be presented to their retiring Treasurer, Mr. Frank Crisp, for his valuable services during the past year." Carried unanimously.

Mr. Vezey thought they ought not to separate without expressing their thanks to the Secretaries and Officers of the Society for their services during the past year. The success of the Society so largely was due to the time and attention which these gentlemen devoted to its interests that the Fellows would, he felt sure, not desire that such services should go unrecognized on the occasion of their Annual Meeting. He therefore asked to be allowed to move that the best thanks of the Society be given to the Secretaries and other Officers and Council of the Society for their valuable services during the past year.

Dr. Braithwaite having seconded the motion it was put to the meeting and carried unanimously.

Prof. Bell briefly responded.

Dr. R. Braithwaite exhibited Drawings and Slides of Mosses illustrating the Presidential Address.

New Fellows:—The following were elected *Ordinary* Fellows:—Dr. Thomas Stewart Adair, Messrs. Charles Adams and Charles Stephen Meachom.

The Journal is issued on the third Wednesday in February, April, June, August, October, and December.

1893. Part 2. APRIL. { To Non-Fellows, Price 6s.

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
J. ARTHUR THOMSON, M.A., *Lecturer on Zoology in the School of Medicine, Edinburgh,*

FELLOWS OF THE SOCIETY.

LONDON:

TO BE OBTAINED AT THE SOCIETY'S ROOMS,

20 HANOVER SQUARE, W.;

OF MESSRS. WILLIAMS & NORGATE; AND OF MESSRS. DULAU & CO.

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CONTENTS.

β. Bryozoa.

Arthropoda.

α. Insecta.

β. Myriopoda.

γ. Prototracheata.

δ. Arachnida.

ε. Crustacea.

Vermes.

α. Annelida.

BOTANY.

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

a. Anatomy.

(1) Cell-structure and Protoplasm.

β. Physiology.

γ. General.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Muscineæ.

Algæ.

Fungi.

Protophyta.

a. Schizophyceæ.

β. Schizomycetes.

MICROSCOPY.

a. Instruments, Accessories, &c.

(1) Stands.

(2) Eye-pieces and Objectives.

β. Technique.

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 $\left(\frac{1}{a}\right)$
	Air ($n = 1{\cdot}00$).	*Water* ($n = 1{\cdot}33$).	*Homogeneous Immersion* ($n = 1{\cdot}52$).	White Light. ($\lambda = 0{\cdot}5269\ \mu$, Line E.)	Monochromatic (Blue) Light. ($\lambda = 0{\cdot}4861\ \mu$, Line F.)	Photography. ($\lambda = 0{\cdot}4000\ \mu$, 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

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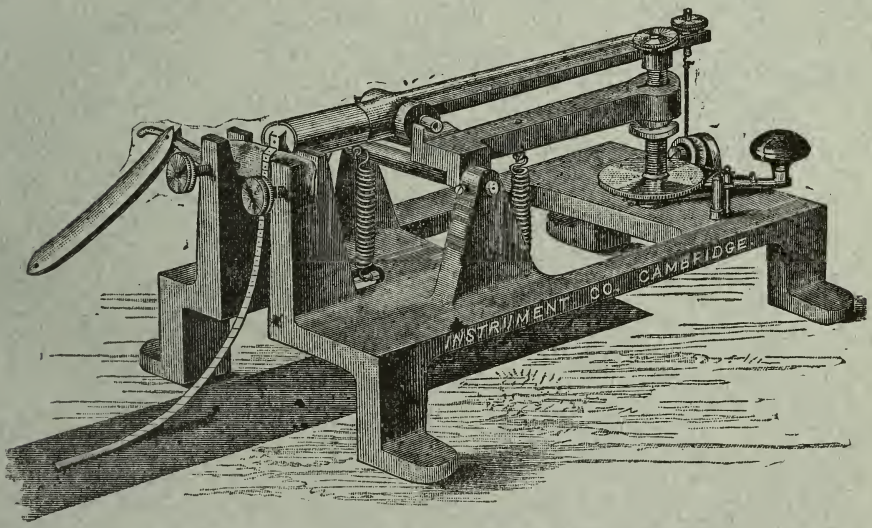

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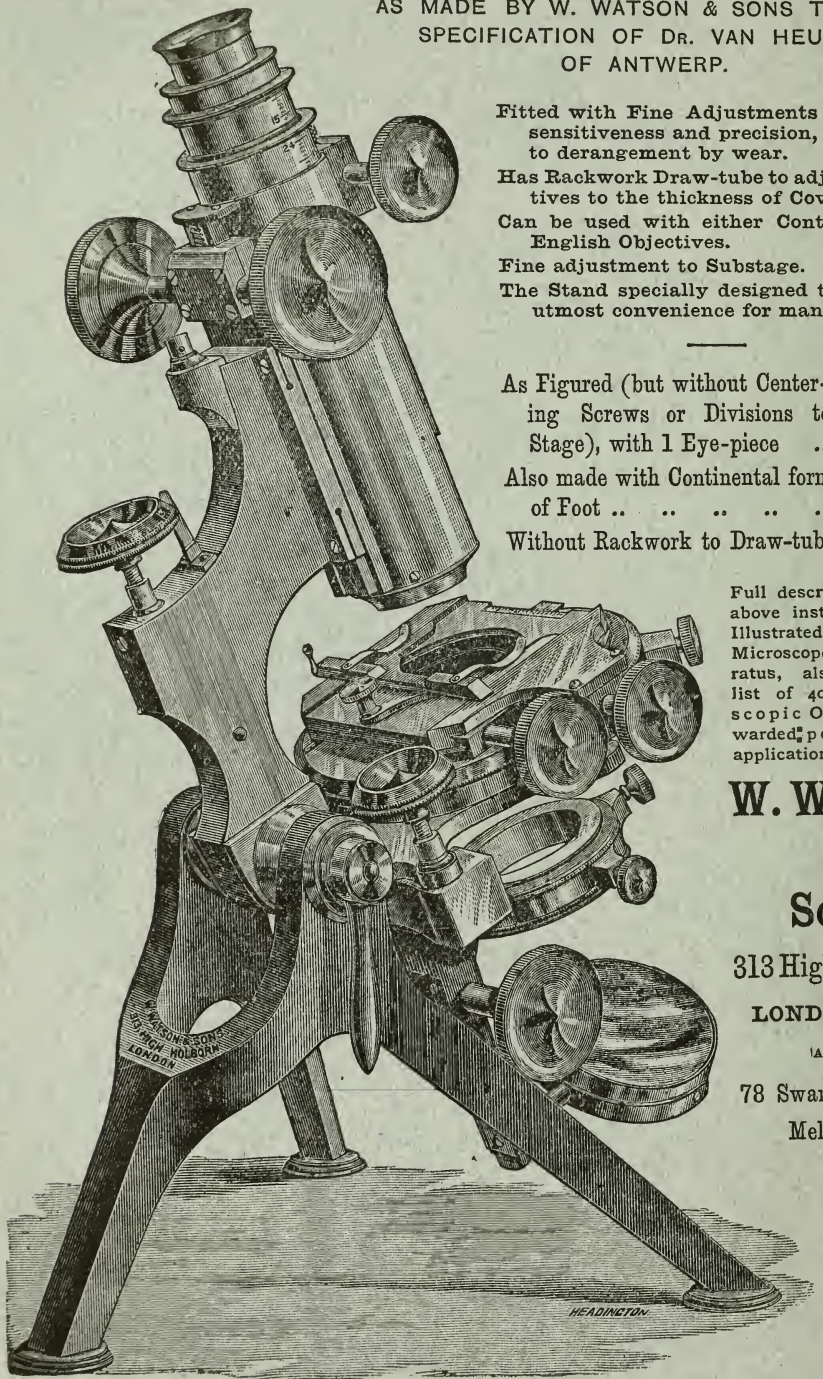

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APRIL 1893.

TRANSACTIONS OF THE SOCIETY.

III.—*The President's Address: On the Anatomy of Mosses.*

By Robert Braithwaite, M.D., &c.

(*Read 18th January*, 1893.)

Last year, as you will remember, I called your attention to the process of impregnation in the higher cryptogams—the Archegoniata—and traced their development so far as the formation of the young plants; I propose now, at least in the Bryophyta, to bring before you their further progress to the perfect state, and summarize what the Microscope has revealed to us of their structure.

We saw that the spores on germinating produced a branched confervoid protonema, from one of the lower joints of which the growth of an individual plant commences. This takes place by a short tubular prolongation from the side of the protonemal cell, which divides by several transverse septa, and its apical cell becomes the commencing bud. Oblique septa arise and subdivide, the first segmented cells being the foundation of the axis, from the lower end of which fine hair-like rhizoids are thrown out, by which the little plant fixes itself to the substratum—the earth, rocks, stones, or bark of trees—and absorbs nutriment; these radicles may be at once distinguished from protonema by the cells being more elongated and the septa between them oblique to the axis. In *Catharinea undulata* (one of the Polytrichaceæ) the roots are very long and coiled round each other like a cable; and, again, in many species the roots bear nodules or tubercles which are capable of developing protonema and young plants. The upper end of the axis elongates into a stem of variable length, which throws off lateral cells to form leaves, and in nearly all mosses becomes coated to a greater or less extent with a felt of rhizoids, adventitious radicles or radicular tomentum, rufous, fuscous, or blackish, by which the stems are matted together into dense tufts, and are thus enabled to retain water like a sponge.

In a transverse section of a strong stem we may observe a central pith of elongated thin-walled cells, and an outer cylinder of wood-cells, and between these the parenchym cells contain chlorophyll and starch, while some of them have their walls greatly thickened, so that

the cell-lumen disappears. These are termed stereid cells, and are of use in affording firmness and support to the stem. The walls of the interior cells are often perforated by small pores, by means of which the cells communicate. The main axis or stem is almost always branched, the shoots or innovations being vegetative only or sexual, and their place of formation is important as it characterizes the two main divisions of mosses: Acrocarpi, when given off at the crown or youngest part of the stem; Pleurocarpi, when produced laterally, from the base or older part of the stem, and thus compared by Limpricht to the cyme and raceme of flowering plants. The main axis in the Acrocarpi usually ends in the inflorescence, male or female, and an innovation is given off laterally below the crown, on which the same process is repeated, so that the growth of the axis is limited; often, as in *Bryum*, two or three innovations are produced under each inflorescence. In the Pleurocarpi the inflorescence is thrown off first near the base on a short lateral branch, and lateral shoots are progressively produced upward, so that the main axis continues its growth in length, and the lateral shoots repeat the plan of the main axis, and the stem becomes pinnate, bi- or tripinnate, as in *Thyidium*. Sometimes the axis is continued as a naked shoot or pseudopodium terminated by a cluster of gemmæ, as in *Gymnocybe palustris*, *Georgia pellucida*, &c., and sometimes it throws out at the base stolons or runners which creep on or below the earth and then throw up erect leafy shoots as in *Climacium* and *Bryum proliferum*. In many species of *Neckera* the lateral branches are attenuated and flagelliform at the ends.

Stems are usually erect, but in pleurocarpous mosses often creeping, sometimes pendent as in *Meteorium*, sometimes floating as in *Fontinalis;* they also generally grow aggregated in tufts or dense cushions, rarely scattered.

We have next to consider the leaves of mosses—those cellular expansions which adorn the stem and are so infinitely varied in form and structure, and, according to the mode in which the papillæ are given off from the three-sided apical cell, do we get the phyllotaxy or arrangement of the leaves on the stem. This is really spiral, and produced by a twisting of the terminal cell in process of growth. When the leaves are most distant we have a bifarious arrangement or 1/2, that is, two leaves in one spiral turn; or trifarious (1/3), three leaves in each turn; but if the leaves are more approximate the number of them in a spiral increases, and we have 2/5 or 3/8—which are most frequent.

The leaves are attached transversely to the stem, and are never lobed or divided; in form they vary between orbicular and subulate, but an ovate or lanceolate outline may be looked upon as most frequent. The lamina is generally traversed by a midrib or nerve of greater or less extent, and sometimes by two, and its cells are unistratose, but occasionally we find two strata in the upper part;

in the Leucobryaceæ the cells are dimorphous and in two strata. On the stems of many pleurocarpous species we find, intermixed with the leaves, smaller leafy organs irregularly lobed or cut up into cellular threads; these are named paraphyllia. The leaves may be entire or serrated or ciliate, and occasionally are surrounded by a thickened border or limb of very narrow cells. The surface is smooth or papillose, and in the aloid Tortulæ the upper side is covered with jointed threads, while in the Polytricha the upper surface of the nerve is beset with vertical laminæ, thus largely extending the assimilating area. The position of the leaves when dry is appressed, twisted spirally or cirrate, but when moist they become erecto-patent, spreading or recurved. The cells composing the leaf-lamina are of the highest importance in distinguishing the genera and species of mosses, and their form and arrangement should be carefully noted by all who study this extensive group of plants.

Two principal forms may be distinguished: (1) parenchymatous, quadrate or hexagonal, sometimes becoming roundish, but their ends are always obtuse, and they are mostly arranged in rows; (2) prosenchymatous, are always more elongated, rhombic, or linear, with their ends triangular; sometimes they are vermicular or twisted, and they often compose the areolation of the upper part of a leaf, while that at the base is parenchymatous. The basal angular, or alar cells are of importance in the Hypnaceæ, and are parenchymatous with wide lumen, and form one or two strata. Cell-walls often become thickened by internal deposit, by which the cell-lumen is diminished in size and dot-like as in *Andreæa, Grimmia, Barbula,* &c., and occasionally nodules and papillæ form on the internal walls, as in *Grimmia* sect. *Trichostomum,* and several Sphagna. Pores may also be noticed in the walls of leaf-cells by which they communicate, well seen in *Dicranum scoparium* and in the transverse partitions of *Leucobryum.* The leaf-cells contain a granuliferous plasma, the outer layer of which (the enveloping layer, until recently called the primordial utricle) is firmer and applied to the inner surface of the cell-wall, and besides the chlorophyll-granules, oil-globules are often present. The midrib gives the leaf firmness, and on section is seen to consist of several cell-layers; generally a row of wide, thin-walled cells occupies the centre, attended by groups of similar smaller cells and supported by stereid cells which are given off from those in the stem, just as the fibro-vascular bundles in the leaves of flowering plants. The midrib projects more or less at the back, where it sometimes bears 2–5 wing-like lamellæ, sometimes several rows of serratures. Water passes up the central pith of the stem and along the midrib to the leaves, where it is transpired, but to a greater extent it takes place the reverse way, being taken up directly by the leaves and the rhizoids of the stem. The inflorescence varies in position and its constituent elements; it is terminal when it ends the main axis, and lateral when developed on an abbreviated lateral shoot; *dioicous* when male and

female are on different plants, *autoicous* when both are on the same plant, *synoicous* when both kinds of sexual organs are combined in one inflorescence, *paroicous* when the antheridia are in the axils of bracts below the archegonia. The floral leaves which enclose the sexual organs are called bracts, and are smaller and thinner than the ordinary leaves; the antheridia are clavate or sausage-shaped with a short pedicel, and are generally accompanied by paraphyses, their walls consist of a single stratum of cells, and their contents are the mother-cells of the antherozoids. The gemmiform male inflorescence is the most frequent, and stands in a leaf-axil or in the fork of two branches in the form of a little closed bud, the perigonial bracts overlapping each other, and drawn together at the apex. Capitate male inflorescence is terminal, somewhat spherical, with an open centre and bracts recurved at apex, as in *Splachnum*. Discoid inflorescence is also terminal, the bracts expanded and larger, and in *Polytrichum* very noticeable by their crimson or orange colour, as also by a new shoot often perforating the disc and also ending in a terminal male inflorescence, which may be repeated in several successive seasons. The archegonia or pistillidia are flask-like with a thick foot, ventricose body, and style-like neck; the wall of the body consists of 1–4 layers of cells.

The Capsule.—The impregnated oospore rapidly enlarges the ventral part of the archegone, and the young sporogone, enveloped in its calyptra, becomes elevated on the seta, which is often of considerable length, generally red or brown, and imbedded by its foot in the tissue of the stem beneath it; its outer cells are strongly thickened, so that it is frequently of wiry texture, and its surface is often rough with small nodules; in drying it becomes flattened and thus twists on its axis, usually the upper and lower parts turning in different directions, the upper part to the left, the lower to the right.

The vaginula encloses the foot and base of the seta, and is often covered with abortive archegonia and paraphyses, and in *Orthotrichum* and a few other genera bears at its apex a short and delicate funnel-shaped tube—the ochrea.

The calyptra invests the capsule in its young state, and consists of one or more strata of cuticular cells, the apex being the withered neck of the archegonium. As soon as it is torn from the vaginula, the seta carries it up on its apex, enclosing and protecting the young capsule, and its form is important for systematic purposes. It takes two principal forms: (1) dimidiate or cucullate, when slit up on one side and sitting obliquely on the capsule, as in *Dicranum* and *Tortula;* (2) mitræform, when regular and erect, the mouth being sometimes fringed or lobed, and the surface being smooth or plicate, papillose or hairy, as in *Orthotrichum*. In *Sphagnum* and *Archidium* the calyptra is large and saccate and tears irregularly.

The capsule, theca, or sporangium is regular when it is symmetric, or irregular when unsymmetric; its form is variable, being

spherical, pyriform, oblong, cylindric or angular, and it may be erect, drooping, or pendulous; the surface has an epidermal layer of flat, empty cells, generally perforated by stomata, by which a communication is maintained between the atmosphere and the interior of the capsule. The stomata have two guard-cells, and resemble those on the leaves of flowering plants; they are either superficial, when on the level of the epidermis; or immersed when below the level of the epidermis, and more or less covered by its cells; the capsules of *Funaria*, *Splachnum*, *Mnium*, *Orthotrichum*, &c., present examples. A flask-like or umbrella-shaped swelling—the hypophysis—is sometimes present between the seta and capsule, very distinct in the genus *Splachnum*.

On transverse section of a fully formed theca we see that it is composed of (1) the capsule wall, (2) an internal air-cavity, (3) the spore-sac with its sporogenous layer, (4) the columella. The spore-sac is generally closely applied to the columella, but in *Polytrichum* an intercellular space separates them. For extremely beautiful figures of sections of capsules I may mention the paper of Lantzius-Beninga, 'Beiträge zur Kenntn. der ausgew. Mooskapsel.' The lower part of the capsule tapers down into the seta by its neck, the upper end being closed by an operculum or lid, flat, conical, or with a long beak, which is, however, wanting in *Andreæa*, and a number of the smallest mosses differing much in habit, which have been grouped together under the term Cleistocarpi, but are more naturally arranged as the lowest forms of families having a similar leaf-structure (*Phascum*, *Ephemerum*, *Acaulon*, *Physcomitrella*, &c.). Between the stoma or capsule mouth and the lid is often found an annulus or ring, composed of one or more rows of large empty cells, flattened, thin-walled, and highly hygroscopic, and by their swelling the lid is lifted off; the outer wall of each of its cells is thickened and does not expand, and thus the annulus often breaks and rolls back as a spiral band.

When the lid is detached that beautiful appendage of the capsule, the peristome, comes into view; in *Georgia* it is represented by four pyramidal masses composed principally of the material of the lid; in the Polytrichaceæ it consists of 16, 32, or 64 non-articulate processes composed of bundles of fine-thickened fibres cemented together by cellular tissue, and bound down at their points to the margin of the epiphragm or dilated apex of the columella, which is left as a layer of cells covering the mouth. In the exotic genus *Dawsonia* these filaments are free and project from the mouth of the capsule like a brush. In most mosses, however, the teeth are formed of thickened plates—only in *Splachnum* do they consist of true cells—and the transverse and longitudinal lines on the outer surface show the dividing lines of constituent cells. In *Seligeria* and *Orthotrichum* the teeth are unistratose, but in most other masses bistratose; the two sides of the teeth are differently hygroscopic, and thus they curve by change of moisture. M. Philibert has written a series of valuable

papers on the peristome in the 'Revue Bryologique,' commencing in 1884, p. 49. He divides the Arthrodontes into Aplolepideæ and Diplolepideæ; in the former each tooth consists of a single row of external plates and a double row of internal as in *Dicranum, Grimmia,* and *Tortula;* in the latter of a double series of outer plates and a single series of inner as in *Bryum, Mnium,* and *Hypnum.* On the inner surface of the teeth are transverse plates or lamellæ formed by the thickened transverse walls of two adjacent cells, and on the outer surface the projecting crossbars or articulations are termed trabeculæ. At base the teeth are united to the inner layer of cells of the capsule wall, and sometimes their points are attached to a little central plate, as we see in *Funaria hygrometrica.*

The colour of the teeth is sometimes very rich, so that they make interesting objects for the Microscope, and we may instance the common *Ceratodon purpureus* and *Funaria hygrometrica, Bryum erythrocarpon,* various species of *Orthotrichum, Mnium,* and *Hypnum* as well worthy of observation.

Occasionally, when the lid is removed, no trace of a peristome is to be seen, and the moss is said to be gymnostomous; this absence of peristome was formerly regarded as of generic importance, but most modern writers now look upon it as evidence of a want of development, and place them in peristomate genera if they agree in leaf-structure and other essential characters.

The endostome or internal peristome is found in the more highly developed species of *Bryum, Mnium, Hypnum,* &c., and arises from the outer wall of the spore-sac; it is a thin transparent membrane composed at base, according to Mitten, of 80 quadrangular cells, and its upper margin projected into sixteen processes which alternate with the outer teeth, and are generally cleft or perforated along the middle line, and in its most highly developed condition, having also 1 to 4 slender articulated cilia between each pair of processes. In *Buxbaumia* and *Webera* the endostome is a plicate tube, in *Cinclidium* the processes are united at the upper part into a dome-shaped membrane, and in *Fontinalis* they are of a brilliant red colour and united by cross-bars. The air-cavity is a ring-like intercellular space between the wall of capsule and the spore-sac, and it is usually traversed by branched chlorophyllose cellular filaments. The columella is the central axis of the capsule enclosed by the spore-sac.

The Sphagna or Peat-mosses differ considerably from the true Mosses, though they present great uniformity of structure among themselves. The stem is more highly organized, a pith of elongated colourless cells occupies the centre, which is surrounded by a cylinder of firm thick-walled cells, the outer layers of which are often richly coloured, and enveloping all is a cuticle of 1–4 strata of large empty thin-walled cells. The branches are in fascicles or bundles, some of which are slender, pendent, and closely applied to the stem, the rest being divergent and arching outward horizontally, and at the summit

they are crowded into a coma or head. The leaves are always nerveless, and composed of two very different kinds of cells—one large, vesicular, and hyaline, of a flexuose form, usually containing spiral fibres attached to the internal surface, and having circular perforations in their walls; the other enclosed between these are very narrow, coloured or chlorophyllose cells, the form and relation of which is best seen by a transverse section. The male inflorescence is on the upper branches, on which the bracts are closely imbricated, and often coloured purple or yellow; and the antheridia are stalked, globose, and stand singly by the side of each bract. The archegonia are like those of the mosses, and after impregnation the capsule is elevated on the end of a long naked branch; the sporogone is globose, with a flat lid, and always without a trace of peristome. Inhabiting moorland bogs, there is great uniformity in the appearance of these plants, and there is great difficulty in deciding what is of specific value, and what is due to change in local conditions. The present tendency seems to be multiplication of species on rather slight grounds, with numerous sub-species, varieties, and forms.

The Hepaticæ, or Liver-mosses, stand lower in the scale than those we have been considering, as is evident by a number of species never passing beyond the thallose stage of development, e. g. *Marchantia, Riccia, Lunularia, Grimaldia,* &c., all differing widely from each other in the form of fruit, but having one organ in common with the leafy forms, namely, the presence of elaters or spiral threads with the spores.

These leafy and branched species represented by the Jungermanniaceæ constitute the bulk of the order, and many at first sight may readily be mistaken for mosses, but the capsule is totally different, having no operculum or peristome, but simply splitting into four valves, and soon passing into decay. The leaves also differ widely from those of the mosses, being very frequently lobed or cut into segments, or having curious little pouches attached; their arrangement is usually bifarious, and there is generally present a series of under-leaves or amphigastria, which differ considerably from the lateral leaves, both in form and size; the plants have thus in most cases a dorsal and ventral aspect. The elaters are very interesting objects for the Microscope, consisting of a long fusiform cell with thin hyaline walls, and on the interior of which run one to three spiral bands.

Until recently the Hepaticæ have been much neglected, and I would point out to some of our botanical friends in want of a hobby —and I like men with hobbies—that they will be well rewarded by taking up the study of these interesting plants, as they offer a field for new discoveries which is certainly rich, and one which will prove certainly attractive.

Of the ten thousand or more species of the Bryophyta, not one can be studied without the Microscope, and even with its aid the

longest life would not be sufficient to make the acquaintance of all the individuals; yet the more work we each of us do in our several vocations, botanical or zoological, the more delight we gain for ourselves, and the more instruction we hand down to the students of the future, who taking up each separate group, may finally complete the roll of all that lives and moves and has its being.

I must crave your forgiveness for my shortcomings during the occupancy of this chair, which I have now the pleasure to transfer to my friend Mr. Michael, a very mitey man indeed, from whom I doubt not we shall receive much pleasure and instruction in the subject he has so specially made his own.

IV.—*The Rotifera of China.*

By Surgeon V. Gunson Thorpe, R.N., F.R.M.S.

(*Read 15th March*, 1893.)

Plates II. and III.

The extensive plains on either bank of the great Yangstze-Kiang river, intersected as they are by innumerable river-like creeks, ponds in which the sacred lotus flower blooms, and ditches which surround on all sides the "paddy" fields of rice and cotton, afford a happy hunting ground, hitherto unexplored as regards the Rotifera, to the microscopist. The richness of life in these fresh waters is astonishing, and the store of new forms amongst all classes of fauna and flora which still awaits discovery, must be immense. This paper (with the exception of one species) includes the work of three months during which H.M.S. 'Peacock' was stationed in the river at Wuhu, a walled city about 260 miles from the mouth. It is necessarily somewhat incomplete, but the abundance of material induces me to publish what has already been accomplished and which I hope in a future paper to supplement. For the present, the drought, the commencement of the cold weather, and the general drainage of the water from the land, now that the rice harvest is over, has interrupted the acquirement of fresh material with which to continue the investigations.

The following European species have been noted:—

Actinurus neptunius.
Anuræa hypelasma.
Asplanchnopus myrmeleo.
Brachionus militaris.
„ rubens.
Cephalosiphon limnias.
Colurus caudatus.
Floscularia campanulata.
Limnias annulatus.
„ ceratophylli.
Megalotrocha semibullata.
Melicerta ringens.
Metopidia triptera.
Noteus quadricornis.
Pedalion mirum.
Polyarthra platyptera.
Proales parasitica.
Pterodina patina.
(Rhinops?) orbiculodiscus.
Rotifer macroceros.
„ tardus.
„ vulgaris.
Triarthra longiseta.

EXPLANATION OF PLATES II. AND III.

Octotrocha speciosa. Fig. 1 *a*, Ventro-lateral view. 1 *b*, Dorsal lobes of corona. 1 *c*, View of corona from ventral aspect, with head of rotifer curved dorsally. 1 *d*, Trophi. α, Upper dorsal lobe. β, Lower dorsal lobe. γ, Lateral lobe. δ, Ventral lobe. ϵ, Dorsal gap in the ciliary wreath.

Trochosphæra solstitialis. Fig. 2 *a*, Dorsal view. 2 *b*, Side view. 2 *c*, Vascular system, showing the connection with the lateral antenna.

Lacinularia megalotrocha. Fig. 3, Dorso-lateral view.

Dinocharis serica. Fig. 4, Dorsal view.

Megalotrocha procera. Fig. 5 *a*, Ventral view. 5 *b*, Side view. 5 *c*, Corona, dorsal view. 5 *d*, Male.

Megalotrocha spinosa. Fig. 6 *a*, Dorsal view. 6 *b*, Side view. 6 *c*, Side view; rotifer in the act of contracting.

Lacinularia racemovata. Fig. 7 *a*, Dorsal view. 7 *b*, Side view. 7 *c*, Ventral view. 7 *d*, Cluster. 7 *e*, Trophi.

Notops lotos. Fig. 8 *a*, Ventral view. 8 *b*, Side view. 8 *c*, Trophi.

Megalotrocha semibullata swarms in almost every pond. Measurements gave the size of the cluster, which is perfectly visible to the naked eye, as 1/14 in. in diameter, the length of the individual rotifer being about 1/28 in.* No gelatinous tubes are present, but the animals secrete a long mucous thread from the united extremities of their feet, to which portions of excreta and other débris adhere, and by which the cluster is suspended from the leaves and stems of water plants and from the sides of the glass vessel which contains them. The thread, however, is very fragile, and the cluster is easily detached; the water seems always to contain many free-swimming clusters.

In this Journal for 1891, p 304, I published a description of a rotifer found in the bogs of Ireland under the name of *Rhinops orbiculodiscus*. This rotifer I have again found in a pond at Wuhu, and now take the opportunity to correct an error, which I much regret, in that I failed to detect a dark red eye situated deeply behind the dorsal antenna. The size of this rotifer is 1/170 in., and in its habits it reminds one of the lively little *Notommata lacinulata*, and like it, it secretes a mucous thread from its toes, by which it anchors. Its classification will probably necessitate the formation of a new genus, but further observations, especially as regards the structure of the trophi, will first be needed.

As regards the new species, a new genus must be formed for the reception of a very beautiful Melicertan; the characters of the genera *Lacinularia* and *Megalotrocha* will need some alteration for the reception of four Rotifera; whilst the genera *Trochosphæra*, *Dinocharis*, and *Notops* are enriched by the discovery of new species.

Family Melicertidæ.

Genus nov. *Octotrocha*.

Gen. Ch.—Corona of eight lobes. Dorsal gap wide.

O. speciosa. Pl. II. fig. 1.

This magnificent creature I found attached to plants in the Wushan Creek, Yangstze-Kiang river, in August 1892. The corona is extremely complicated, and consists of eight lobes, which are wrapped, as it were, around the head of the animal like a bonnet. Four dorsal lobes (fig. 1 *b*, *a*, β), corresponding to those which grace the genus *Melicerta*, are prolonged at their sides to form ventro-laterally two ventral lobes (fig. 1 *c*, δ), and downwards two lateral lobes (fig. 1 *c*, γ). The fringe of cilia is continuous, except between the two lower dorsal lobes (fig. 1 *b*, β), where a very wide dorsal gap exists (fig. 1 *b*, ϵ). The rotifer inhabits a gelatinous tube of a yellowish colour, to which extraneous particles adhere. This is pro-

* This differs somewhat from the measurements given in this Journal, 1889, p. 613.

bably secreted by several nucleated glandular cells situated in the foot. The *nutritive system* follows the usual type of the Melicertidæ. The *mastax* is large, and the trophi (fig. 1 *d*) powerful, orange-tinted, and of the malleo-ramate type, the unci 4-toothed, and non-symmetrical, the teeth when closing appearing to interlock. The *stomach* is capacious, and large gastric glands are present. The *vascular system* consists of two lateral canals, each with four vibratile tags. These lead into an extremely small contractile vesicle, at the side of the rectum, just before its termination in the cloaca. The two *ventral antennæ* are small, but obvious; a dorsal antenna was not detected. The *chin* is conspicuous, but small. Two very minute red *eyes* were detected, deep-set, and close together, the lenses of which showed up well under pressure after treatment with liquor potassæ. The *foot* is about the same length as the body, and contains numerous muscles. The animal is solitary, but is by no means timid, readily expanding in all its beauty after any slight disturbance. Length 1/14 in.

Trochosphæra solstitialis. Pl. II. fig. 2.

Sp. Ch.—Free-swimming. Sphere unequally divided by the ciliary zones.

In January 1889, I had the good fortune to find in a pond in Brisbane, Australia, the wonderful rotiferon *Trochosphæra æquatorialis.** It was therefore with no small pleasure that I came across, in a pond in Wuhu, in August 1892, a new and distinct species belonging to this remarkable genus. If, for the purpose of illustration, we compare the spherical body of this rotifer to the form of the earth, then, in the case of *T. æquatorialis*, the wreath of cilia encircles the sphere as the line of the equator does the earth, whilst in *T. solstitialis* it encircles it like the Tropic of Cancer ("*Circulus solstitialis*") dividing it into two unequal segments, of which the oral, containing all the organs of the body, is three times greater than the aboral. In addition to this division by means of the ciliary zone, the rotifer can be again divided by means of an imaginary plane passing vertically behind the eyes at right angles to the zone, into dorsal and ventral portions, the *dorsal* containing the mouth, digestive system, and cloaca, the lateral canals, the nervous ganglion, the eyes and lateral antennæ, and the *ventral* portion containing the ovary and the ventral antenna. I am aware that this description differs from that of *T. æquatorialis*, given by Dr. Hudson, in the monograph of the "Rotifera," but we have a good precedent for placing the buccal orifice on the dorsal surface in the genus *Conochilus*, by which means the other organs retain their relative positions, the ovary being towards the ventral surface, and the nervous ganglion and the cloacal orifice on the dorsal; at the same time the gap in the ciliary wreath

* This Journal, 1891, p. 301; Proc. Roy. Soc. Queensland, 1889, p. 71.

is ventral whilst the so-called dorsal antenna should in reality be known as the ventral antenna, the fact of its being unpaired not absolutely militating against this proposition, since we have in *Conochilus unicornis* (a recently discovered species *), the two ventral antennæ in process of fusion.

The general anatomy of this rotifer resembles that of *T. æquatorialis*. The secondary wreath is small, and fringes the oral side of the buccal orifice. The buccal funnel, which has a pair of large leaf-like salivary glands, leads into a powerful mastax. The trophi appear to be of a rudimentary malleo-ramate type, but though I observed them, I am sorry that I made no sketch, an omission I hope to rectify on a future occasion. A long slender œsophagus leads into a capacious stomach, with gastric glands on either side. This is followed by a large intestine ending in the cloaca. The cloacal orifice appears as a transverse slit at the lower part of the dorsal surface.

As regards the *nervous system*, a large ganglion situated just above the buccal orifice sends nerve-threads to the ventral antenna, the two lateral antennæ, the two eyes, and the buccal funnel. The nerve to the *ventral antenna* passes straight across the body-cavity, on a level with the ciliary wreath,† to the centre of the ventral gap, where it turns down and ends in the ventral antenna about the centre point of the middle line of the ventral surface. The nerves to the *lateral antennæ* pass toward the ciliary zone, and on a level with it, and then suddenly turn downwards to end in the lateral antennæ at the junction of the lower fourth with the upper three-fourths of the body. The lateral antennæ are in close connection with the vascular system. The two *eyes* are situated on the ciliary wreaths, a little to the dorsal side of a meridian line bisecting the sphere. Each consists of a beautiful crimson hemisphere surmounted by a clear hyaline lens (fig. 2 *c*).

The main mass of the *Vascular System* is suspended on either side of the body-cavity, just below the eyes and the ciliary zone (fig. 2, *c*). The lateral canals are entirely separate from what is evidently analogous to the granular floccose material which generally surrounds them, but which in this case is differentiated into a separate organ, which I regard as the "*nephridium*," consisting of an intricate network of winding and intercommunicating canals, lying close under the cutis, and lined with cells having large yellow nuclei. The nephridium communicates below with the lateral antenna, and both above and below with the lateral canal. To the limited portion of the lateral canal between these junctions are attached the *vibratile tags*, five in number, each vibratile tag consisting of a cylinder crowned with a conical cap, and containing a long flagellum. The main canal passes towards the dorsal surface, sending an off-shoot

* Journ. Quek. Micr. Club (1892) ser. ii. vol iv. p. 367.

† In *T. æquatorialis*, Dr. Semper describes this nerve as passing close beneath the cutis of the aboral hemisphere. Mon. Micr. Journ., xiv. (1875) p. 238.

back to communicate with the lateral antenna, and it therefore becomes a question whether the function of this so-called antenna is other than that of a sense-organ. The *contractile vesicle* is in close connection with the cloaca, but it is still a moot point as to whether the lateral canals open into it or into the cloaca. I am inclined to think that they really do open into the contractile vesicle, for I several times observed, though not invariably, that they were dragged downwards, on the contraction of the vesicle. Also the addition of carmine to the water, as suggested by Dr. Hudson,* did not reveal the presence of a return current through the cloacal aperture during the diastole of the contractile vesicle.

The *ovary* is flat and ribbon-shaped (fig. 2, *b*), and curved in a horse-shoe form, similar to that of *Notops clavulatus*, and on this account I am inclined to propose the transference of the genus *Trochosphæra* from the family Melicertidæ to the family Hydatinidæ, as an aberrant form. The collapsed oviduct can be detected as a filmy thread passing from the ovary to the cloaca. The *winter eggs* are similar to those of *T. æquatorialis*, being covered with long spines, and the central part undergoing unequal binary division.†

Four pairs of *muscle-bands* of different lengths are attached from the ciliary zone to the inner surface of the cutis below, drawing the ciliary wreath into graceful sinuous curves. Their function, however, appears to be abortive, as nothing analogous to the contractions seen in other Rotifera has been detected.

The four Rotifera about to be described belong to the genera *Lacinularia* and *Megalotrocha*, the characteristics of which will need further modification. As these rotifers are evidently near the divisional line, across which these two genera blend, it is difficult to feel absolute certainty in which genus each should properly be placed. I propose the following definitions of these genera:—

Common Characteristics.—Individuals solitary or in clusters; fixed or free-swimming; corona a modification of an ellipse, oblique, with a ventral sinus, and a dorsal gap in the ciliary wreath.

Lacinularia.—Individuals with adhering gelatinous tubes.

Megalotrocha.—Individuals without adherent gelatinous tubes; trunk with or without opaque warts, spines, &c., and with or without an "oviferon." ‡

Lacinularia megalotrocha. Pl. II. fig. 3.

Here is a rotifer inhabiting a gelatinous tube, and possessing a corona similar to that of *Megalotrocha alboflavicans*, but carrying no opaque warts on its trunk. The *corona* is kidney-shaped, oblique, with its shorter axis placed dorso-ventrally, and with a deep ventral sinus; dorsal gap in the ciliary wreath very minute. The *trophi* are

* This Journal, 1891, Presidential Address, p. 14.

† This Journal, 1891, pl. vi. fig. 1 *d*.

‡ For definition of this term see below, p. 151.

malleo-ramate, and the rest of the digestive system follows the usual type. The ventral *antennæ*, consisting of two small setigerous pimples, are well defined. No *eyes* were detected. Touching the rectum, but evidently not connected with it, is an organ, bulbous in shape, from which a duct passes down to the foot. Its function must be for the present problematical. The *foot* also contains three glandular bodies, presumably for the secretion of the mucus composing the tube which surrounds it. In one or two specimens the whole body-cavity was filled with an enormous number of oval hyaline vesicles in chains, probably of a parasitic nature.*

Length 1/25 in. Habitat: attached to water-plants in a pond in the Botanical Gardens, Singapore, April 1892, in company with *Stephanoceros Eichornii*, *Melicerta ringens*, &c.; also in the Wu-shan Creek, Yangstze-kiang river, China, August 1892.

Lacinularia racemovata. Pl. III. fig. 7.

The colonies consist of free-swimming clusters of a most unusual shape. Each cluster, consisting of about 150 individuals, is a prolate spheroid, revolving on its long axis, which is nearly twice the length of the shorter axis (fig. 7 *d*). The individual rotifers inhabit coherent gelatinous tubes, and are united along the long axis of the cluster. The *corona* is broad, the shorter diameter being placed dorso-ventrally, with a shallow ventral sinus, and with the gap in the ciliary wreath very wide. The *trophi* are of the malleo-ramate type, but somewhat peculiar in structure (fig. 7 *e*), the unci four-toothed, the rami three-sided, with their striæ evanescent. Two minute red *eyes*, with clear transparent lenses, are situated in the corona, below the secondary wreath. The two *ventral antennæ*, one on each shoulder below the corona, are obvious. The *dorsal antennæ* are probably represented by a ciliated pit on each side of the corona, from which spring cilia longer and thicker than those in the ciliary wreath.

Size: length of cluster 1/10 in.; breadth 1/17 in.; length of detached individual 1/57 in. Habitat: a pond at Ye-ki-shan near Wuhu, August 1892.

Megalotrocha procera. Pl. III. fig. 5.

This species was found in August 1892, attached to water-plants in a lotus pond at Wu-shan, Yangstze-kiang river. The clusters are very large and conspicuous to the naked eye, looking like flakes of wool against the green leaves. The species is chiefly characterized by the enormous length of the foot, which is three-fourths the length of the whole animal. No gelatinous tubes are present. Like *M. alboflavicans*, four opaque warts stretch from shoulder to shoulder

* Perhaps these were the *Trypanococcus Rotiferorum* of Prof. von Stein. See 'The Rotifera,' i. p. 104.

across the ventral surface just below the corona. In shape, the *corona* is somewhat similar to that of the above-named species, but the ventral sinus is deeper. Its surface is raised above the level of the ciliary wreath, roofing over the buccal funnel. Below the opaque warts, two *ventral antennæ* are conspicuous. The *eyes* are absent in the adult, but can be seen in the unborn young whilst still *in ovo*. The *buccal funnel* is richly ciliated, and particles of food revolve in it and form a pellet, before passing into the short pharynx which leads into the mastax. The *trophi* are malleo-ramate and of a yellowish tint. A long, narrow and winding œsophagus, richly ciliated, leads into a capacious stomach. The *lateral canals* terminate in the cloaca, their junctions being easily seen. No contractile vesicle is present. The *vibratile tags* are large, there being five on each side in the body, and two pairs in the corona. The *oviduct* can be traced from the ovary to its termination in the cloaca. In my account of *M. semibullata* in this Journal,* I first published a description of a peculiar expansion from the dorsal surface, near the junction of the body with the foot, to which the ova were attached after extrusion from the cloaca. This egg-bearing organ, at that time unique, I now propose to designate the *oviferon*. In *M. procera* it is conspicuous, but in a rudimentary condition, being merely a protuberance surmounted by three small knobs, and often has as many as four eggs attached to it. How the ova become fixed to this structure is still a question for future decision.

I had the good fortune to find the male (fig. 5 *d*), the anatomy of which follows the usual type, possessing a circular wreath of cilia, two bright red eyes, a foot, and sperm-sac with penis.

Size: diameter of cluster 1/6 in.; length of individual 1/10 in.

Megalotrocha spinosa. Pl. III. fig 6.

This new species I found in a pond at Kowloon, on the mainland opposite the island of Hong Kong, in May 1892, in company with *M. semibullata*. The colonies consist of free-swimming clusters, visible to the naked eye, and similar in size to those of the last-named rotifer. No opaque warts are present, but the upper portion of the ventral surface of the trunk is covered with numbers of sharp spines, arranged in no definite order. This rotifer has a curious method of contraction, curving herself into the form of the letter S, with the corona tucked well inwards, so that the spines stand out prominently (fig. 6 *c*) and evidently serve as weapons of defence. The *corona* is somewhat square-shaped, the ventral cirrus shallow, and the gap in the ciliary wreath small. Two minute red *eyes* are conspicuous on the upper edge of the corona, between the two rows of cilia.†

* This Journal, 1889, p. 615.

† Two other Rotifera, viz. *Megalotrocha semibullata* and *Lacinularia natans*, have their eyes in this unusual position. Journ. Quek. Micr. Club, January 1891, p. 254.

Neither dorsal nor ventral *antennæ* could be detected, though the latter may possibly lie hidden amongst the spines. The *oviferon* is well developed, and is a cup-shaped organ into which the trunk of the rotifer is inserted, supported by side buttresses, and with a central process to which the eggs are attached. The *foot* is extremely small, so that the ovifera lie together at the centre of the cluster. The *eggs* are longer and more slender than usual, with one end narrower than the other. No gelatinous tubes are present, but like *M. semibullata*, the animals secrete a mucous thread by which the cluster is occasionally suspended from the water plants.

Dinocharis serica. Pl. II. fig. 4.

This rotifer is not unlike *D. Collinsi*, possessing as it does, eight dorsal spines and a large ruby eye. It is, however, relatively broader, the distance between the spines of the posterior edge being greater. Also the spurs in the foot are absent. The lateral edges of the lorica are finely serrated, three of the teeth on each side of the shoulders being especially conspicuous. In all other respects its anatomy appears to follow that of *D. Collinsi*.

Size 1/170 in. Habitat: a pond at Wuhu, July 1892.

Notops lotos. Pl. III. fig. 8.

This new species is evidently a link between *N. clavulatus* and *N. brachionus*, since in its general contour it resembles the former rotifer, whilst its corona is similar to that of the latter. The corona bears three styligerous prominences between the two wreaths, each surmounted by a fan-like arrangement of styles. The *trophi* are of the malleate type, and the digestive and glandular systems are similar to those of *N. clavulatus*. The *nervous system* is represented by a large *ganglion* with a crimson *eye* seated on its ventral side and sending nerve-threads to the large *dorsal antenna*, and to the two conspicuous *ventral antennæ*, situated on either side of the ventral surface below the middle line. The *ovary* is ribbon-shaped, and curved like a horse-shoe. The *lateral canal* on either side can be traced into a large *contractile vesicle*.

Size 1/50 in. Habitat: lotus ponds at Wuhu, August 1892.

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.†

Experimental Embryology.‡—Dr. W. Roux gives an account of the experiments which he, Chabry, Driesch, Fiedler, Hertwig, Chun, and others have made in regard to the development of one of the two first blastomeres of an ovum. Discrepancies in detail there may be, but this general result seems certain: in Chordate, Echinoderm, and Cœlenterate types it has been shown that from one of the first two segmentation-cells, separated from or bereft of its neighbour, a typical half-development or hemiplast results, and that from this, at an early stage in ova with little yolk (*Echinus*, *Ascidia*), at a later stage in ova with a considerable amount of yolk (*Rana*, Ctenophora), there results a "post-generation" of the deficient half-body, a complete "hemiooholoplast" or "microholoplast."

Herr C. Herbst § has made numerous interesting experiments showing the (indirect) influence of the chemical composition of the medium on the development of sea-urchin ova. In a mixture of 1860 ccm. sea-water and 140 ccm. 3·7 per cent. potassium chloride solution, the formation of the calcareous needles in the larvæ was delayed, they were eventually formed to a slight extent but abnormally, the characteristic pluteus-processes were not formed, but otherwise the larvæ were normal. Probably the absence of the supporting needles involved the absence of

* 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.

‡ Verhandl. Anat. Gesell., vi. (1892) pp. 22–62.

§ Zeitschr. f. Wiss. Zool., lv. (1892) pp. 446–518 (2 pls.).

the processes, for it is likely that the needles supply some stimulus to growth. The author then discusses the occurrence of fused pluteus larvæ and the origin of blastulæ from parts of ova. Experimenting further with potassium chloride mixtures, he evoked larvæ with an exaggerated tuft of cilia at the animal pole, but he failed at Naples to repeat with success this experiment which he had made at Trieste, and believes that the failure was due to the different temperature conditions. By adding lithium salts to the water strange results were produced. The normal blastula elongates and divides into two vesicles, one thin-walled, the other thick-walled; the thin portion Herbst has reason to call the "gastrula-wall portion," the thick portion is the "archenteric portion"; they differ also in pigmentation and in their cilia; calcareous needles were rarely formed; a special connecting region arises between the two main portions; and other peculiarities were exhibited before death put a stop to the strange development. The experimenter believes that plutei would after all have developed out of some, had they lived. By adding more and more lithium salt he was able to reduce the "gastrula-wall portion" almost to nil. The thick-walled portion is really a protruded archenteron; the connecting portion is the hind-gut of the pluteus. It is interesting to notice that the influence of the various salts of lithium (chloride, nitrate, bromide, and iodide) is inversely as their molecular weights, the chloride being most powerful, the iodide least powerful. The results go to show that the production of the abnormalities in development is due not to a direct chemical reaction, but to the changed physical conditions, and especially to the changed osmotic pressure of the medium.

Yolk-cells and Yolk Segmentation.*—Herr Hs. Virchow continues his discussion of the vertebrate yolk-organ. It is either a diverticulum of the mesenteron (lamprey, sturgeon, amphibians) or a sac with a duct (Selachii, Teleostei, Amniota). The endoblast of the yolk-organ occurs in two forms—peripheral layer and internal cell mass, epithelial cells and yolk-cells. In discussing the homology of various yolk-organs, attention must be directed to the topographical relations, to the primary circulation, and to the parietal appendages (if any). There are two great types, that of Selachii (and Teleostei), and that of Amniota (and Amphibia). Yolk-cells are either true cells or only cell-territories (merocytes). Yolk-segmentation differs from typical segmentation in three ways:—The resulting cells are not again divided, they have from the first the size of tissue-cells, they are from the first yolk-cells and nothing more. Nuclei are distributed in the yolk, and around these nuclei cells are defined off. A typical illustration is found in *Ichthyophis*. "Deferred segmentation," which occurs in reptiles and slightly in birds, is not to be confused with yolk-segmentation. Yolk-segmentation leads to the formation of yolk-cells and to nothing else; but yolk-cells may also arise by typical segmentation or from yolk-free cells.

Development of Auditory Ossicles.†—Dr. Baumgarten has investigated this in a human embryo. He has followed Born and Strasser in

* Verhandl. Anat. Gesell., vi. (1892) pp. 209–20.
† Archiv f. Mikr. Anat., xl. (1892) pp. 512–30 (1 pl.).

making a model reconstruction from his sections. His conclusion corroborates that of Reichert (1837) that the malleus and incus develope from the cartilage of the first visceral arch. As to the stapes, he maintains that the hyoid cartilage contributes to its development, or, very probably forms the whole of it.

Degeneration of Ovarian Ova in Lizards.*—Herr Strahl has studied this in *Lacerta viridis*. Females were kept apart from males, and the mature ova being undischarged underwent degeneration. The nucleus becomes vacuolated and disappears; the polar protoplasm of the ovum is divided into small pieces; the yolk becomes more fluid; leucocytes invade the walls of the follicle and absorb yolk-particles, and the whole egg becomes smaller. Further stages were not observed, for the lizards could not be kept alive for more than a year.

Spermatogenesis in Sauropsida.†—Herr C. Benda finds that the archiplasm in the mammalian spermatide consists (*a*) of a pale homogeneously stainable portion (which comes to nought), and (*b*) of a vacuole with a deeply stainable body, which forms the apical cap of the spermatozoon. The chromatoid accessory body discovered by Hermann has two parts; one, often annular, comes into relation with the spiral thread of the intermediate piece of the spermatozoon; the other part seems to become the terminal knob of the axial thread. It is doubtful whether this chromatoid accessory body be archiplasmic.

The ripe spermatozoon of the sparrow has an anterior and a posterior portion in its head; the anterior portion is stained green or violet with acid anilin, the posterior portion is stained red with basic anilin. In the spermatide the archiplasmic sphere lies in a small depression of the nucleus, but increases until it is as large as the nucleus. The two lie apposed like two hemispheres. Near the boundary between nucleus and archiplasm lies the extremely minute accessory chromatoid body. The archiplasmic hemisphere comes to occupy the proximal or anterior pole, and a new structure—a deeply stainable grain—appears within it; the accessory chromatoid body comes to lie at the distal or posterior pole. Further stages show that the anterior portion of the head of the spermatozoon is due to the archiplasm. The grain within the archiplasm seems to disappear. At the distal pole there appears the tail. Most of the chromatoid body lies as a short rod at the origin of the tail, but it is likely that a special part is separated off as the terminal knob.

Development of Vertebral Column of Anura.‡—Herr C. Hasse finds that the toads have, like fishes and Urodela, not only a cuticula chordæ (or elastica interna), formed from and surrounding the notochord, but also a cuticula sceleti (or elastica externa), which is formed from the skeletogenous layer. Frogs are, like the Amniota, without a cuticula sceleti, and have only a cuticula chordæ. The Anura are thus intermediate between fishes and Urodela, in which there is a special cuticula sceleti, and the Amniota, in which there is not only no cuticula sceleti but a marked reduction of the cuticula chordæ.

* Verhandl. Anat. Gesell., vi. (1892) pp. 190–5. † Tom. cit., pp. 195–9.
‡ Zeitschr. f. Wiss. Zool., lv. (1892) pp. 252–64 (1 pl.).

Doubling of Chromosomata in Nucleus of Selachian Ova.*—Prof. J. Rückert, having investigated *Pristiurus* and *Scyllium*, comes to the conclusion that in the young ovarian ovum (*Eimutterzelle*) the chromatin framework is an enormously enlarged daughter-coil of the primitive ovum (*Urei*), whose chromosomata have been doubled and arranged in pairs. The doubling occurs in the transition from primitive ovum to young ovarian ovum, presumably by a peculiar longitudinal cleavage of the chromosomata in the dyaster stage of the last division of the primitive ovum.

Hermaphroditism of Lampreys.†—Dr. J. Beard notes the occurrence of a well-marked ovum among the spermatozoa in the testis of a lamprey. Whether this condition is general in every male lamprey is not yet known. It is obviously of interest in connection with the hermaphroditism of *Myxine* (Cunningham, Nansen, Retzius), and the general problem of hermaphroditism. In reference to *Myxine* the author notes that the young forms have several rows of teeth along the roof of the mouth, a fact suggestive of some metamorphosis in the hag as well as in the lamprey.

Theory of Mesoderm and Metamerism.‡—Prof. N. Cholodkowsky finds that the Metazoa may be distributed into three groups—Enterocœla, Genitocœla, and Acœla. To the first belong the Brachiopoda, Echinoderma, Chætognatha, Chordata, and Enteropneusta. In the Genitocœla the cœlom is said to arise in the compact mass of mesoderm, which corresponds to the sexual tissue of Platodes. It is not necessary to admit the existence in them of mesenchyme; in some exceptional cases the gonads arise from special cells which are, as in Insects, differentiated before the formation of the germinal layers; here are all Cœlomata that are Enterocœla. The Acœla are the Cœlentera, Porifera, Platodes, Nemertini, Orthonectida, and Dicyemida.

The metamerism of the cœlom of the Metazoa has a double origin and significance. In some animals (Enterocœla) it consists in the segmentation of various internal organs, and is due to the metameric ramifications of the intestine; in the Genitocœla it may be referred to linear budding.

Metamerism of Vertebrates.§—Prof. B. Hatschek corrects his previous conclusion that the posterior nerve roots, which in *Amphioxus* and *Ammocœtes* are septal or inter-segmental, and the anterior roots, which are myal or segmental, so unite in higher Vertebrates in the spinal nerves, that a posterior root unites with the anterior root in front (rostrad), and that the ramus dorsalis ascending to the skin runs in the posterior (caudad) septum of the myotome. This is wrong. A posterior root unites in all higher Vertebrates with the subsequent (caudad) anterior root, and the branches follow the anterior myoseptum. He gives a table illustrating the relations which he believes to be correct.

* Anat. Anzeig., viii. (1892) pp. 44–52 (2 figs.).
† Tom. cit., pp. 59–60.
‡ Congrès Internat. Zoologie, II. i. (1892) pp. 58–65.
§ Biol. Centralbl., viii. (1892) pp. 89–91.

Terms of Auxology.*—Messrs. S. S. Buchman and F. A. Bather propose a modification of the terms applied by Prof. Alpheus Hyatt to the successive ontogenetic stages.

Hyatt uses—	The authors propose—	Literary equivalents are—
1. Embryologic.	Embryonic.	Embryonic.
2. Næpionic.	Brephic.	Infantine or Larval.
3. Nealogic.	Neanic.	Adolescent.
4. Ephebolic.	Ephebic.	Adult or Mature.
5. Geratologic.	Gerontic.	Senile.
a. Clinologic.	Catabatic.	Declining.
β. Nostologic.	Hypostrophic.	Atavic.

The authors offer a justification for proposing these changes, define their own terms, and give examples with remarks. As to the word Auxology itself, they point out that growth and change do not stop when the embryonic stage has been passed, but that owing to this branch of science having had no term it is in danger of not being recognized.

Cyclopian Monsters.†—Prof. C. Emery discusses those cases in which paired organs, e.g. eyes or ears, fuse in the ventral middle line in the young embryo. Eyes and optic nerves may fuse, and from the unpaired eye a tube or proboscis leads to an opening in a closed cavity. This tube the anatomists regard as a rudiment of the nose; zoologists will think of the nasal passage of Cyclostoma. Prof. Emery suggests that the proboscis corresponds to the nose, plus the hypophysial pouch, that the latter has come to be præ-ocular, and that the fusion or close approximation of the optic stalks closes the path to the infundibulum. He does not believe that hypophysis or nose can be referred to gill-clefts, but maintains that the homologues of the œsophageal ring, i.e. the optic rudiment and the fore-brain, mark the anterior limit of the gill-cleft region. From a teratological standpoint he has some other interesting suggestions to make.

β. Histology.

Relationships and Role of Archoplasm during Mitosis in the Larval Salamander.‡—Mr. J. E. S. Moore finds that, with respect to the cells which form the undifferentiated genital ridge of Vertebrates, Platner's generalization concerning the spermatocytes of Invertebrates that "there is a genetic connection between the coiled network, the spindle fibres, and the archoplasm," is wonderfully borne out. The archoplasm is an accompaniment of the attraction sphere in the leucocytes of the larval Salamander, and exhibits a metamorphosis, the known phases of which correspond with those in larger and more easily elucidated elements. All the cells described by the author are little differentiated, and he believes that the ease with which the archoplasm is discernible in the reproductive cells has been the sole cause of its association more parti-

* Zool. Anzeig., xv. (1892) pp. 420–1, 429–34.
† Biol. Centralbl., viii. (1892) pp. 52–7.
‡ Quart. Journ. Micr. Sci., xxxiv. (1892) pp. 181–97 (1 pl.).

cularly with them; as a matter of fact, it appears to be an essential factor in a type of division which is widespread among the tissues of both Vertebrates and Invertebrates.

Wandering (Migrating) Cells of the Frog.*—Messrs. A. A. Kanthack and W. B. Hardy have investigated the structure and functions of the wandering cells of the Frog, a term they prefer to "leucocyte" or "white corpuscle," since it is more inclusive. They find that the histology of the wandering cells of the Frog is almost identical with that of the same cells in *Astacus*. The normal forms are eosinophile, hyaline, and basophile cells; the abnormal giant-cells formed by fusion of hyaline cells, nucleated cells budded off from the eosinophile or the hyaline cells, and non-nucleated bodies produced by the breaking up of red corpuscles. They have been able to observe the conflict between cells and bacilli for continuous periods of 8 to 9 hours, the same cells and bacilli having been watched for the whole period.

An account is given of the phenomena observed when lymph is treated with anthrax bacilli. The eosinophile cells are strongly attracted to the anthrax; they apply themselves to the chains of bacilli, and when contact is absolutely or nearly effected, their cell-substance is profoundly stimulated, and exhibits quick, streaming movements; the eosinophile spherules are next discharged. If these cells are present in sufficient numbers to match the anthrax they bud off daughter-cells; these creep a short way from the point of conflict and develope spherules at one end. Later on, they seek the same or another focus of conflict. In time an eosinophile plasmodium is formed, but whether these cells or the bacilli win the fight, depends largely on their relative numbers. The bacillus is only injured near the eosinophile cell, and there the contents become rapidly curdled and irregular in appearance. If the bacillary chains are in great number the eosinophile cell will extend itself to most attenuated lengths in order to be able to attack as great a length of chain as possible. Even when the chain is not directly attacked the near presence of eosinophile cells greatly arrests its development.

If the cells win they early recharge themselves with spherules, but they are no longer eosinophile—they are amphophile, or stain rather more readily with methylene-blue than with eosine. Up to this point the hyaline cells, or phagocytes, remain quiescent, and in the neighbourhood of a healthy bacillus they appear to be paralysed.

Later on, however, these hyaline cells increase in number, approach and fuse with the eosinophile cell-masses surrounding a bacillus; the object of the hyaline cells is to draw the elongated mass into a ball. Still later, the cells of the mass commence to regain their individuality, and slowly separate. When individual cells are again to be seen, the mass is found to consist of a central giant hyaline plasmodium, formed by the very complete fusion of the hyaline cells, and enclosed by a crust of eosinophile cells. Yet still later the mass separates into the original four hyaline cells.

Whilst these changes are in progress the rose-colouring cells are increasing in size and number; their function appears to be the removal

* Proc. Roy. Soc. Lond., lii. (1893) pp. 267–73.

of foreign noxious substances in solution in the plasma; if the bacterial poisons accumulate beyond a certain point they paralyse the eosinophile and destroy the hyaline cells.

The conflict, then, consists in (1) the maiming of the bacilli by the eosinophile cells, (2) the removal of the remains of the bacilli by means of the ingestive and digestive activity of the hyaline cells, and (3) the removal of dissolved foreign substances by the rose-staining cells.

The authors point out that in the Crayfish, the Lamprey, and the Frog, there is now evidence of different forms of wandering cells; those may be classed as granular eosinophile and non-granular hyaline which are found free in the body fluids, and rose-reacting granular cells which are found in the fluid, and in the spaces, of connective tissue. The archetype is to be seen in the granular, protective, digestive, absorptive and constructive blood-cell of *Daphnia;* the eosinophile cell has accentuated the first two of these characters; the hyaline cell is digestive, and the rose-staining cell absorptive.

Alleged Intracellular Origin of Red Blood-corpuscles.* — Dr. A. Spuler maintains that this is all a mistake. He has followed the observations of Ranvier and others, and has never found red blood-corpuscles or parts of them in cells which were not connected with capillaries. In the "vaso-formative cells" associated with the capillary network, no new formation, but a destruction of red blood-corpuscles, occurs. Several authorities have described vaso-formative cells not in connection with the capillary system, but these are artificially produced. There is no such thing as the intracellular origin of red blood-corpuscles.

Centrosomata and Attraction Spheres in Resting Cells.†—Dr. D. Hansemann directs attention to the occurrence of centrosomata in the cells of cerebral tumour, in carcinoma, and other pathological tissues. He has always missed them in resting epithelial and glandular cells, and in vascular endothelial cells, in man. They are very distinct in the mesenteric connective tissue of newly born kittens and rabbits. The author believes that they are constant in cells, but that they often or always lie during the resting stage within the nucleus, and only emerge into the cytoplasm as division begins. This is also Hertwig's view.

Granula-Theory.‡—Prof. Altmann has been able to detect an intergranular network in the resting nucleus. The coarser reticulum of other histologists is due to the local thickening of the intergranular network. The latter shows the same staining reactions as does the so-called chromatin of the dividing nucleus. The substance of the network consists of fine granules, and to these the coarser granules in the meshes are due. The intergranular network, or rather "the monoblastic granula" which composes it, is the essential substance.

γ. General.

Terminology of Position and Direction.§—Prof. F. E. Schulze lays down the following laws for the terminology of position and direction in animals:—Each term should have but one meaning, it should express

* Archiv f. Mikr. Anat., xl. (1892) pp. 530–52 (1 pl.).
† Anat. Anzeig., viii. (1892) pp. 57–9.
‡ Verhandl. Anat. Gesell., vi. (1892) pp. 220–24.
§ Biol. Centralbl., xiii. (1893) pp. 1–7.

some definite stereometric relation, it should be intelligible in itself, it should be congruent with other related terms, it should be short, correctly formed, and if possible pleasant, and, if an adjective, it should have a termination like that of related terms, e. g. those terms expressing position may end in *al* (or *an*), and those expressing direction in *ad*.

All not quite irregular bodies may be grouped according as their middle is definable by a point, a line, or a plane. Thus, we have synstigma, syngramma, and sympeda. The stereometric ground-form of the synstigma is represented by a sphere or a regular endospheric polyhedron. Around the centre is the central or proximal region, the direction leading to it is centrad or proximad. So we have a distal region and distad direction. Position may be expressed by centran and distan. The syngramma may be an ellipsoid, a straight cylinder, a cone, or a spindle, &c.; the line in relation to which all parts of the body are symmetrical is the principal axis, and at its end, if we follow a terminad direction, we reach there a terminan position. What lies in the principal axis is axian, directed towards it is axiad, away from it in a distad direction are distan positions. The plane of the principal axis is meridian, and parallel to this are parameridian planes. So we have transversan and paratransversan. The sympeda have three axes—two heteropolar and one isopolar; of the heteropolar, one is the principal axis, the other dorso-ventral; the isopolar axis is perlateral. All in the principal axis is axian; its two ends are rostral and caudan. Related terms are rostran and caudan, rostrad and caudad, dorsan and ventran, dorsad and ventrad. The two ends of the perlateral axis are dextral and sinistral, with dextran, sinistran, dextrad, and sinistrad as correlated terms. The author goes on to define the median plane separating dextral and sinistral, the frontal plane separating ventral and dorsal, and the transversal plane separating caudal and rostral.

Theory of Sex.*—Messrs. J. A. Thomson and N. Wyld have made a critical review of recent contributions to the biology of sex, especially those of Ryder, Hartog, and Weismann. While accepting in the main the general theory stated in 'The Evolution of Sex' by Geddes and Thomson, the authors advocate the following amendment:—"In contrasting the sexes or their reproductive elements, the contrast must be expressed in ratios; the storage of potential energy in a female need not be absolutely greater than in the corresponding male, but in the female the ratio of anabolic to katabolic processes is greater than the corresponding vital ratio in the male. In the great majority of cases, of the food assimilated and stored by a male the greater amount is used, after growth has ceased, for movement and general functions, the reproductive function making relatively small demands on the nutritive store; while in the female organism a relatively great amount is used for the formation of ova or for the nutrition of the embryo. The female organism is one in which the general ratio of anabolism to katabolism (the mean of many ratios) is greater than the corresponding general ratio in the male."

Evolution of Sex.†—Dr. C. J. Wynaendts Francken seems to believe that the male organism inclines to greater activity, the female to greater

* Proc. R. Phys. Soc. Edin., xi. (1891–2) pp. 249–82.
† Tijdschr. Nederland. Dierk. Ver., iii. (1892) pp. 206–225.

passivity, a conclusion analogous to that maintained by Geddes and Thomson in their book entitled 'The Evolution of Sex,' of which, however, the author does not appear to be aware. The author discusses primary and secondary sexual characters, the determination of sex, the appearance of sexual dimorphism, embryonic hermaphroditism, parthenogenesis, polar bodies, the import of fertilization, consanguinity in pairing, and heredity.

Movements of Plants and Animals.*—Herr C. Bay communicates some historical notes, more interesting than important, in regard to interpretations of movements in plants and animals. F. C. Sibbern (1819–43), Eschricht (1845), Pflüger, Panum, Johannsen, are referred to.

Classification of Animals.†—Prof. J. von Kennel thinks that we must forego the division of the Animal Kingdom into phyla, and speak of "classes" or "cycles"; of these he recognizes seventeen—1. Protozoa. 2. Spongiæ. 3. Cœlentera. 4. Echinoderma. 5. Plathelminthes. 6. Nemathelminthes. 7. Rhynchelminthes. 8. Nemertini. 9. Rotatoria. 10. Bryozoa. 11. Mollusca. 12. Brachiopoda. 13. Tunicata. 14. Annelides. 15. Branchiata. 16. Tracheata. 17. Vertebrata.

These may be arranged thus:—

I. Protozoa.

II. Metazoa.

1. Radiata. { Spongiæ. Cœlentera. Echinoderma.

In 2. Bilateralia, two alternative groupings are given:—

a. Insegmentata.
- Plathelminthes.
- Nemathelminthes.
- Rhynchelminthes.
- Nemertini.
- Rotatoria.
- Bryozoa.
- Mollusca.

b. Segmentata.
- Brachiopoda?
- Tunicata?
- Annelides.
- Branchiata.
- Tracheata.
- Vertebrata.

or *a.* "Animaux à 'gastrula.'"
- Plathelminthes.
- Nemathelminthes.
- Rhynchelminthes.
- Nemertini.

b. "Animaux à 'trochosphæra.'"

α. Insegmentata.
- Rotatoria.
- Bryozoa.
- Mollusca.

β. Segmentata.
- Brachiopoda?
- Tunicata?
- Annelides.
- Branchiata.
- Tracheata.
- Vertebrata.

Classification of Animal Variations.‡—Prof. A. Brandt gives, which no one has yet offered, a synoptic classification of Animal Variations. These may be I. Spontaneous, when they are (*α*) strictly individual, (*β*) proper to the vital cycle, (*γ*) proper to the sex, (*δ*) proper to future

* Biol. Centralbl., xiii. (1893) pp. 37–8.
† Congrès Internat. Zoologie, II. i. (1892) pp. 68–72.
‡ Tom. cit., pp. 66 and 7.

generations; or the variations may be II. Acquired; these may be (α) due to external actions, mechanical, physical, chemical, or composite, (β) due to function, such as use or disuse, or (γ) to pathological processes, or (δ) correlated with the preceding variations. Lastly, variations may be inherited (α) from parents, (β) indirectly, by influence, (γ) by atavism, from ancestors.

Biological Regions and Tabulation Areas.*—The principles which appear to have dominated Mr. C. B. Clarke in the preparation of this memoir appear to be chiefly these. The preparation of biological regions presupposes a tabulation of material on some geographical framework; the use of natural biological regions to tabulate upon has been found inexpedient, and is absolutely impracticable as, with increasing knowledge, their boundaries become ever more complex; if naturalists would agree to tabulate on one geographical framework, each might have every liberty in making out his own regions and subregions for exhibition of his results; and yet all the advantages aimed at by Mr. Wallace in enforcing the employment of one set of regions might be secured. The framework of areas and subareas which the author puts forward will be best understood if his maps, which we cannot reproduce, be consulted at the same time.

B. INVERTEBRATA.

Blood of Invertebrata.†—Dr. A. B. Griffiths has a general review of the characters of the blood in various groups of invertebrate animals, in which the results of other observers are incorporated, with original investigations; some of these we have from time to time noted.

Nervous Tissues of Invertebrates.‡—Dr. A. B. Griffiths has investigated the chemical constitution of the nervous tissues of various Molluscs and Arthropods. He finds that, as in higher animals, the constituents are very liable to chemical change; in Insects and Crustacea neurokeratin is replaced by neurochitin, the composition of which is C = 50, 21; H = 7, 64; N = 4, 86.

Report on Animal Parasites.§—Dr. M. Braun commences his report with an account of general works. That of Looss ‖ should appeal to a wide circle of readers. L. v. Graff,¶ *inter alios*, deals with the relation of parasites to man and domestic animals. L. G. Neumann ** has an extensive work on the parasites of domestic animals, which is illustrated by numerous figures, and has a carefully prepared bibliography. J. Frenzel †† discusses the relation of enteric parasites to the digestion of living tissue.

* Phil. Trans., 183 B (1893) pp. 371–87 (2 maps).
† Proc. Roy. Soc. Edinb., xix. (1892) pp. 116–30.
‡ Comptes Rendus, cxv. (1892) pp. 562 and 3.
§ Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 59–61, and 99.
‖ 'Schmarotzerthum in der Thierwelt,' Leipzig, 1893, 186 pp.
¶ 'Die auf den Menschen übertragbaren Parasiten der Hausthiere,' Graz, 1891, 40 pp.
** 'Traité des maladies parasitaires non microbiennes des animaux domestiques,' Paris, 1892, 767 pp., 364 figs.
†† "Die Verdauung lebenden Gewebes und die Darmparasiten," Arch. f. Anat. u. Phys. (Phys. Abth.), 1891, pp. 293–314.

Mollusca.

γ. Gastropoda.

Affinities of Groups of Gastropoda.*—M. E. L. Bouvier finds that *Actæon solidulus* is a transitional form not only between Prosobranchs and Opisthobranchs, but between the latter and the Pulmonata. Some arguments in favour of this view are stated, but they will probably be clearer when the author has an opportunity of explaining himself more fully.

So-called Primitive Kidneys of Gastropods.†—Dr. R. v. Erlanger notes the absence of the so-called *Urniere* from Cephalopods, Amphineura, and Solenoconcha. The term includes ectodermic external, and mesodermic internal, primitive kidneys. The former have as yet been observed only in marine Prosobranchs, and consist merely of one or several large ectoderm cells which lie on each side of the embryo behind the velum. Erlanger confirms Bobretzky's account of the enlargement of these cells, and the union of the vacuoles of the cells into a saccule containing a brown substance. In *Capulus* there is but one of these large ectoderm cells, so that *Capulus* leads on to *Vermetus* where there is not even one. Nor are there primitive kidneys in Heteropods, which are generally regarded as pelagic Prosobranchs. The internal primitive kidneys are either wholly mesodermic (in Opisthobranchs only), or the duct portion is in great part ectodermic (freshwater Prosobranchs, Pulmonates, and Lamellibranchs). The internal mesodermic kidney of Opisthobranchs is a closed sac with colourless fluid. Fol found no trace of these organs in Pteropods. Of their origin in *Aplysia*, Mazzarelli writes to Erlanger that they appear as two groups of mesoderm cells near the posterior and ventral margin of the velum, and that a closed cavity developes within the group. The author refers to his own description of the *Urniere* in *Paludina* and *Bythinia;* that of Lamellibranchs is more complicated; that of freshwater Pulmonates yet more so. It seems to the author that the external primitive kidneys of the marine Prosobranchs are really homologous with those of other Gastropods and Lamellibranchs.

Nephridial Gland of Prosobranchs.‡—Dr. R. v. Erlanger finds that in the embryo of *Capulus hungaricus*, the nephridium is a single sac. Bobretzky has shown the same for *Fusus*, as has v. Erlanger for *Triton nodosus* and *Nassa mutabilis*. These facts are against Perrier's hypothesis that the nephridial gland, such as *Capulus* and others have, represents a degenerate left (after torsion) nephridium. The author is inclined rather to regard the gland as an acquired differentiation of nephridial tissue or possibly as an ectodermic gland secondarily fused with the nephridium. At all events, *Capulus* shows no trace of a paired nephridial rudiment.

Development of Cassidaria.§—Dr. R. v. Erlanger describes some abnormal phenomena in the development of *Cassidaria echinophora*. Each pea-like capsule of the large round mass of spawn contains about 300 ova; there is not space enough for all of these to become larvæ, hence the abnormalities. The unfertilized ovum showed at one pole a

* Comptes Rendus, cxvii. (1893) pp. 68–70.
† Biol. Centralbl., xiii. (1893) pp. 7–14.
‡ Zool. Anzeig., xv. (1892) pp. 465–8. § Op. cit., xvi. (1893) pp. 1–6 (3 figs.).

cap consisting of a few irregularly arranged cells. In other cases the egg was further surrounded by a layer of flat epithelial cells, below which a few others of similar appearance were also to be seen. The appearance, contrasted with normal segmentation, suggested a pseudo-ectoderm and pseudo-mesoderm. In *Murex brandarius* similar abnormalities occur in early stages. But in *Cassidaria* the abnormality may persist so that the dwarf embryos, resulting from the peculiar segmentation, reach a veliger stage. The author directs the attention of those who work at experimental embryology to what he has described.

Shell-Structure.*—Dr. J. Thiele begins with a description of the shell of *Chiton*. It has four layers, periostracum, tegmentum, articulamentum, and hypostracum. In *Arca*, he describes periostracal glands which probably help in forming the periostracum, and notes how the glandular mantle epithelium, which is locally modified into attaching epithelium, forms an hypostracum distinct from the ostracum formed from the outer surface of the mantle-fold. The tegmentum of *Chiton* is an ostracum, the articulamentum has no equivalent among Lamellibranchs, the innermost layer is an hypostracum. In almost all types the ostracum and hypostracum are distinguishable, and many illustrations are given. The ostracum is primary, traceable to the cuticula of Amphineura, and ontogenetically oldest; the hypostracum is secondary, and effects the attachment of the muscles to the shell.

δ. Lamellibranchiata.

Structure of Cuspidaria and System of Lamellibranchiata.†—Prof. C. Grobben describes *Cuspidaria* (*Neæra*) *cuspidata* Olivi, corroborating some of the results of Pelseneer's recent work, but in regard to some points giving different descriptions and drawing different conclusions. He describes a byssus-gland in the foot, the branchial septum with its complex musculature (almost wholly striated), its five pairs of clefts, and its mechanical function in causing water-currents in the mantle chamber, the gut (in regard to which he has little to add to Pelseneer's account), the kidneys which lie *behind* the pericardium and in general characters are very like those of Najadæ, the entire absence of blood-vessels and their replacement by sinuses, the freedom of the rectum from the ventricle, the respiratory function wholly discharged by the mantle, and the nervous system (in regard to which Pelseneer's account is almost completely confirmed). While Pelseneer described his *C. rostrata* as hermaphrodite, Grobben finds that *C. cuspidata* has separate sexes, and he gives reasons showing that Pelseneer must have been mistaken. The author agrees with Pelseneer's union of *Poromya*, *Silenia* (= *Cetoconcha*), and *Cuspidaria* in a group of Septibranchiata, but he would not grant the group more than subordinal value.

Phagocytosis in Gills of Lamellibranchiata.‡—M. de Bruyne states that, if we cut off a fragment of a gill of, preferably, a *Mytilus*, and examine it with Zeiss oc. 4 and obj. F (magnification 1010) an examination can easily be made of the blood-corpuscles. At the edge of the epithelium a wandering corpuscle may be seen to leave the con-

* Zeitschr. f. Wiss. Zool., lv. (1892) pp. 220–51 (1 pl., 1 fig.).
† Arbeit. Zool. Inst. Univ. Wien (Claus), x. (1892) pp. 101–46 (4 pls.).
‡ Comptes Rendus, cxvi. (1893) pp. 65–8.

nective tissue, and to pass among the ciliated cells. These last will soon show distinct signs of change; their protoplasm appears to have been gnawed out where it has been in contact with a leucocyte. In this way there may be formed large lacunæ in which move a more or less large number of leucocytes, each playing the phagocyte on its own account; the bodies of these cells often increase in size considerably.

In specimens preserved with Flemming's or Hermann's fluid the author has often been able to demonstrate the presence of degenerate leucocytes, either in the phagocytes or in the tissues; although found in the most varied forms, they are always composed of an irregular element which stains slightly or not at all, and which serves as the substratum for one or more safraninophilous cells; the substratum was of protoplasmic origin, while the chromatic element was derived from the nucleus. The author comes to the conclusion that we have here to do with another example of the continual strife between the cells of a single organism and the removal of weakened, discarded, or dying anatomical elements by amœboid cells which are still in full vital activity. The ciliated cells of the lower edge of the branchial lamellæ are, by their very situation, exposed more than any other to every kind of destructive cause; they are, therefore, rapidly weakened and used up, and their weakened bodies have an attraction for the leucocytes.

South American Najadæ.*—Prof. H. von Jhering has made a study of the Najadæ (= Unionidæ and Mutelidæ) of S. Paulo. Between *Unio* and *Castalia* he finds that *Castalina* g. n. is transitional, and the three genera might be united. In S. American Najadæ it is the *inner* gill-plate which shelters the embryos. A Glochidium larva occurs in South American forms, in *Unio*, *Castalina*, *Castalia*, and perhaps in *Lyria*, but it cannot be said that the S. American species of *Unio* have the same development as those of Europe. The peculiar Lasidium larva of *Glabaris* is described. Then follow notes on the hinge-teeth, &c. Von Jhering characterizes as Mutelidæ those which have a Lasidium, as Unionidæ those which have a Glochidium.

The descriptive part of the memoir takes account of 30 species, of which *Glabaris Nehringi*, *Fossula Balzani*, *Plagiodon Balzani*, *Castalina Nehringi*, *C. Martensi*, *Unio paulista*, *U. Greeffeanus*, *U. Caipira*, *U. Martensi*, *U. Frenzellii* are new.

Von Jhering concludes with a long discussion of the "Archiplata" freshwater fauna, so puzzling in its distinctness from the rest of South America, and in its relations with Australia and New Zealand, and even with Africa. In regard to the last point, he postulates an ancient land connection between Africa on the one hand and Brazil and Guiana on the other.

Molluscoida.

a. Tunicata.

Studies on the Protochordæ.†—Mr. A. Willey, in his first memoir under this title, discusses the origin of the branchial stigmata, præoral lobe, endostyle, atrial cavities, &c., of *Ciona intestinalis*, and has some remarks on *Clavelina lepadiformis*. He has completely altered his views as to the homologies between the various organs of the Ascidians and

* Arch. f. Naturg., lix. (1893) pp. 45–140 (2 pls.).

† Quart. Journ. Micr. Sci., xxxiv (1893) pp. 317–60 (2 pls.).

Amphioxus, being led, by the position of the endostyle, to conclusions diametrically opposed to those of van Beneden and Julin.

His chief results are to be thus summarized:—

(1) The first four primary stigmata of *Ciona intestinalis* are developed from one primitive gill-slit.

(2) Three pairs of gill-slits, in the form of six primary stigmata, are represented in *Ciona* and other simple Ascidians. In *Ciona* the innumerable branchial stigmata of the adult are derived by subdivision from these six primary stigmata, and not by new perforations.

(3) The endostyle of *Ciona* is at first quite anterior in position, lying in front of the mouth, with its primary long axis at right angles to its definitive long axis.

(4) The cavity in the fixing stolon is the præoral or anterior body-cavity, and contains loose mesoderm cells derived from the two lateral mesodermic bands.

(5) This stolon, which is at first quite anterior, has its position reversed by the rotation of the body of the Ascidian through a right angle.

(6) The walls of the atrial cavities of Ascidians are essentially ectodermic, there being no difference in this respect between the somatic and visceral walls.

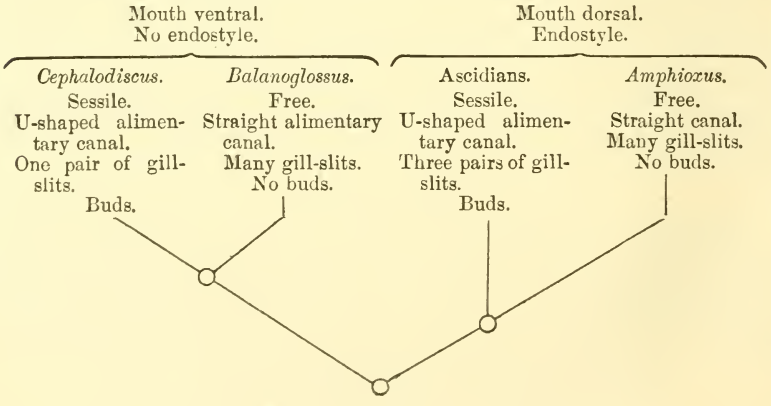
(7) The pericardium of Ascidians arises from the endoderm of the branchial sac, and the heart has no endothelium.

(8) The heart of *Ciona* arises by the splitting apart of the two layers of the septum which primarily divided the pericardium into two halves.

(9) On the whole, the development of *Clavelina*, as compared with that of *Ciona*, is greatly modified in the direction of abbreviation. With this may be correlated the development of the former in the peribranchial cavity, and the possession by the eggs of much more yolk than is found in those of *Ciona*.

The history and structure of the heart of Tunicates leads the author to accept the view of Van Beneden and Julin that it is a special organ in the group of Urochorda, and that it is not homologous with the heart of Vertebrates.

The author gives the following scheme to show his view of the relations of the Protochorda:—



Eyes and Central Nervous System of Salpa.*—Mr. M. M. Metcalf has been able to study the chain and solitary forms of eleven species of *Salpa*. In the solitary form of all species the eye has a horse-shoe shape; this is not the case in any chain form, but each species has its own characteristic eye, all of which exhibit a fundamental conformity to a definite type; in the course of their development the eyes of all the chain-forms pass through a stage in which they are horse-shoe shaped.

A subneural gland is always more or less well developed, and consists of two chambers beneath the brain, one on each side of the middle line, and each is connected with the peribranchial chamber by a comparatively large cylindrical duct. These structures appear to be homologous with the lateral ducts of *Phallusia mammillata*, which connect the subneural gland with the peribranchial chamber. The subneural gland is most highly developed in *Salpa africana-maxima*.

In the course of its development the nervous system of *Salpa* passes through a stage in which it almost exactly resembles the nervous system of a nearly mature *Doliolum;* in *S. africana-maxima*, which is, in this respect, the most primitive of the species studied, a remnant of this stage is retained in the adult. There is a solid wart-like antero-ventral protuberance from the ganglion; a solid rod of cells is continued forward from this protuberance, which soon fuses with the wall of the pharynx, and finally dwindles to a small hollow tube which can be traced to the ciliated funnel.

The ganglion of *Salpa* is homologous with the visceral portion of the larval Ascidian nervous system; in the embryonic condition there is an anterior thin-walled tube which opens to the ciliated funnel, and, later on, atrophies, and there is a posterior portion with a thickened ventral wall. The cells of the dorsal wall of the latter region proliferate to form the dorsal two-thirds of the ganglion, while the ventral third is formed by the thick ventral wall, which persists after the obliteration of the lumen of the neural tube. The cells corresponding to the sensory vesicle seen in the Tunicates lie in the thin-walled anterior portion, all of which atrophies. The ganglion of *Salpa* is, therefore, homologous with both the ganglion and the subneural gland of Ascidians (if, of course, Van Beneden and Julin's account of the development of the gland be correct); this homology is of importance as the eye of *Salpa* is formed from the ganglion. This eye cannot, therefore, be homologous with the eye of the Ascidian tadpole, as the latter is found in the sense-vesicle; nor can the eye of *Salpa* be homologous with the pineal or the lateral eyes of Vertebrates, as these are derived from the first primary brain-vesicle, while that of *Salpa* is formed from a secondarily acquired ganglion, derived from a more posterior portion of the nervous system, and one not represented in Vertebrates.

The author calls attention to some points which militate against the recently expressed view of Prof. Bütschli† as to the probable phylogenetic development of the lateral eyes of Vertebrates. Bütschli's description of the "primitive eye" does not correspond to the condition of any eye seen by Mr. Metcalf. The horse-shoe-shaped eye does not arise by the tripartition of a simple eye, but is distinctly horse-shoe-shaped from its first appearance. But the most important evidence is

* Zool. Anzeig., xvi. (1893) pp. 6–10. † See this Journal, 1892, p. 775.

that the eye of *Salpa* is derived from a portion of the nervous system which is not represented in Vertebrates.

Optic Organ of Salpa.*—Dr. E. Göppert has investigated the optic organ in five species of *Salpa*,—*S. africana-maxima* Forsk., *S. scutigera-confœderata* Cuv.-Forsk., *S. runcinata-fusiformis* Cham.-Cuv., *S.* (*Cyclosalpa*) *pinnata* Forsk., *S. democratica-mucronata* Forsk. The eye most resembles that of Ascidians and *Pyrosoma*, but is decidedly different from either, and is homologous with an ordinary Vertebrate eye only in the wide sense that it arises from part of the central nervous system.

In the *solitary* forms the organ arises in a horse-shoe-shaped dorsal portion of the ganglion, consisting of central fibrous substance and a peripheral layer of cells. Some of the marginal cells become optic cells—large, polyhedral, club-shaped, or pyramidal elements, with the thicker nucleated end towards the light. In one case there were spindle-shaped cells between the club-shaped cells. In most cases the optic cells contain "phæospheres," and peculiar thickenings of the cell-walls, both probably with the function of rods. The sensitive elements occur in groups; the largest group is horse-shoe-shaped, and associated with a pigment-layer which excludes the rays of light, except in definite directions. In *S. democratica-mucronata* the nerve-fibres unite with the ends of the sensitive elements which are towards the light, but in *S. pinnata* the reverse is the case. This difference is, however, explained by structural peculiarities. In all but *S. democratica-mucronata* there is an eye-chamber formed by a shield of epidermis; this is of nutritive, but perhaps also of optical significance. The organ is not such as renders the forming of an image possible; it is, however, well adapted for the localization of rays of light.

In the *social* forms the optic organ is stalked, and protrudes obliquely forwards and downwards. Groups of cortical cells form retinæ and are provided with a pigment-layer, though, except in *S. democratica-mucronata* there are also groups without pigment. In general features the sensitive cells resemble those in the solitary forms, but there is great variety in the disposition of the groups. In three cases the optic cells of the posterior part of the retina have their ends towards the light in connection with the nerve-fibrils, while in the anterior part the ends away from the light are so connected. The solitary forms "see" for the most part only dorsally, while the social forms can "see" ventrally as well. The advantage of this is explained. The optic organ is chiefly important in the orientation of the animals, e. g. as regards their distance from the surface of the water.

β. Bryozoa.

Embryonic Fission in Cyclostomatous Polyzoa.†—Mr. S. F. Harmer gives an account of a case of embryonic fission in *Crisia ramosa*, found at Plymouth, which appears to be without parallel in the Animal Kingdom. His general results are as follows:—

(1) The ovicell, which is morphologically equivalent to a zoœcium, develops in the same way as an ordinary zoœcium.

* Morphol. Jahrb., xix. (1892) pp. 250–94 (3 pls., 1 fig.).

† Quart. Journ. Micr. Sci., xxxiv. (1892) pp. 199–241 (3 pls.).

(2) In the young ovicell a polypide bud is found, which consists of a tentacle-sheath, and a part which represents the alimentary canal of a polypide.

(3) With this last one of some small egg-cells present in various parts of some of the growing points becomes closely related.

(4) The alimentary canal grows round the ovum, and becomes a compact multinucleated follicle; the egg at first lies in an excentric cavity of this follicle.

(5) The ovum segments, and the blastomeres may, in early stages, be completely separated from one another.

(6) Meanwhile the ovicell is maturing, and soon becomes shifted to some distance from the growing point, owing to the superposition of new zoœcia above it; its non-calcified aperture becomes constricted, and grows out into a long tubular orifice.

(7) At the end of segmentation the embryo consists of a small mass of undifferentiated cells, lying near the distal end of the follicle; this last now forms a spherical knob which projects freely into the interior of a spacious tentacle-sheath.

(8) The follicle becomes vacuolated, and is soon transformed into a nucleated protoplasmic reticulum, while the tentacle-sheath loses its distinctness.

(9) The number of blastomeres increases, but, as at all other stages, excepting the earliest, cell-limits are indistinguishable.

(10) The embryo, now considerably increased in size, although remaining a solid mass, without differentiation of organs, grows out into several finger-shaped processes, which are generally directed towards the distal end of the ovicell.

(11) The finger-shaped processes are divided up by a series of transverse constrictions into rounded masses of cells, each of which becomes a complete larva.

(12) This process of embryo-formation continues during the whole functional period of the life of the ovicell, and even proceeds actively at a stage when many of the embryos are mature or nearly mature. More than one hundred (secondary) embryos may be present at any one time in one ovicell, and they are all produced by budding from one "primary embryo."

(13) Each "secondary embryo" acquires its well-known two layered condition at the time of its separation from the budding mass of embryonic cells. It developes in a vacuole of the protoplasmic reticulum, which presumably nourishes it.

These facts explain the considerable difference in the structure of the Cyclostome larva, as compared with that of other marine Polyzoa; and at the same time explains why it is that no observer has ever succeeded in giving an account of any process corresponding to egg-cleavage in the Cyclostomata.

Comparing his results with those obtained by other workers on other groups, Mr. Harmer reminds us that in Tunicates, Cœlenterates, as well as in Polyzoa, there are remarkable cases of the formation of buds from slightly differentiated masses of cells; and it is in these three groups that budding in the adult condition is a more normal event than in other groups of animals. In them, it is further to be noted, that, just

as in the Trematoda, precocious fission is not characteristic of the whole group, but occurs sporadically.

The examination of other cases seems to indicate that some of the abnormal points in the development of *Crisia* may be due to the nutritive conditions in which the development takes place. Just as the presence of food-yolk within the egg modifies the character of the segmentation and germ-layer-formation, so the presence of copious stores of nutrient material in the maternal tissues outside the egg may affect the early processes of development. For example, the large number of relatively large larvæ which develope from the minute egg of a *Crisia* could not be produced if the egg were not supplied with nutriment from outside itself. On the other hand, the extreme independence of the blastomeres at an early stage may be connected with the acquirement by the embryo of a habit of forming buds in the embryonic condition.

General History of Marine Polyzoa.*—The Rev. T. Hincks publishes another part of his 'Appendix'; certain modifications are proposed in the genus *Steganoporella* and its allies; doubt is thrown on the distinctness of the genus *Stirparia;* there is a detailed discussion of the characters of *Farcimia appendiculata;* there are remarks on various other species, and some answers to criticisms.

Statoblast of Phylactolæmata.†—Dr. P. Demade, from a study of the statoblast in *Alcyonella fungosa* and *Cristatella mucedo* comes to the conclusion that the statoblastic mass is a tissue, and its membrane is composed of cells which undergo a cellular differentiation.

Arthropoda.

Parthenogenesis.‡—Prof. O. Taschenberg has an interesting historical survey of parthenogenesis, accompanied by a very full bibliography. It is almost half a century since the theory was first started, and it has succeeded in the important work of showing us that fertilization is not a necessary preliminary to the development of the animal egg.

Compound Eye of Arthropods.§—M. H. Viallanes has a contribution to this much discussed question. In his summary of the morphology of the eye of *Palinurus vulgaris* he describes the ommatidium as consisting of (1) a cornea, (2) corneagenous cells, two in number, and applied to the inner face of the cornea, (3) four crystalline cells, which appear to secrete (4) a cone. This cone is always formed of four segments, and in it there can be distinguished three regions—the crystalline, the vitreous and the filamentar. The filaments are attached to the basal membrane. The next constituent, or retinula, is formed by the rhabdom and the seven cells which surround it. In the fresh state the rhabdom is coloured rose by chromatopsine; it is a fusiform body with seven salient costæ, which are the rhabdomeres. The retinular cells contain a quantity of pigment in their inner part, but none in the outer; they are separated from one another by masses of pigment

* Ann. and Mag. Nat. Hist., xi. (1893) pp. 175–82.
† La Cellule (1892) viii. pp. 347–78 (2 pls.).
‡ Abhandl. Naturf. Ges. Halle, xvii. (1892) pp. 367–453.
§ Ann. Sci. Nat., xiii. (1892) pp. 349–84 (2 pls.).

which refract the light strongly, and so resemble those which enter into the constitution of the tapetum of the eye of Mammals.

The basal membrane is pierced by holes which give passage to the nerve-tubes which go to the ommatidia; these holes are arranged in pentagons. Seven cylinder-cones are destined for each ommatidium, and as they traverse the basal membrane they lose their sheath.

The author thinks that the results at which he has arrived are of a kind to throw a new light on the physiology of the vision of Arthropods, and he directs attention especially to the fuller information which he is able to give of the structure of the ommatidium, as compared with that of his predecessors. He is of opinion that the observations of Parker, of himself, and even of Patten are sufficient to cause the rejection of the theory of retinophores; although this was, when proposed, received with much enthusiasm, it was founded on errors of observation, and it is to be wished "that it should cease to encumber any longer treatises and manuals of zoology."

Experiments on the eyes of Insects and Crustacea show that, in the Insect, a real and inversed image of external bodies is found in each ommatidium; it coincides with the internal face of the crystalline cone, which is in immediate contact with the retinula. Although small the retinular image is distinct and extends over an angle of about 45°. In the Crustacea, in the same way, the crystalline lens forms on the retinula a real and reversed image of external bodies; but, in this type, the refractive media have a very long focus and the retinula is separated from the lens: the interval between them is filled up by a substance which is the analogue of the vitreous body of vertebrates. In both cases it would appear that light does not act directly on the rods; these latter can only receive impressions through the intermediation of the retinal cells. The retinal images of Arthropods are much less perfect than those of vertebrates; but on the other hand the eyes of the former are better adapted for seeing bodies set in relief, and the movements of bodies.

a. Insecta.

Colours of Insects.*—Mr. A. B. Griffiths has determined the composition of the green pigment which is found in the wings of Lepidoptera and other groups; he ascribes to it the empirical formula of $C_{11}H_{10}Ag_2N_8O_{10}$; and, as by prolonged boiling with hydrochloric acid, the pigment is converted into uric acid, he suggests that it is deposited in the wings by wandering cells. He gives it the provisional name of lepidopteric acid.

Reactions of Lepidopterous Pigments.†—Mr. F. H. Perry Coste has continued a line of research briefly alluded to in his former papers,‡ and has investigated the conditions under which certain yellow Lepidoptera may be reddened by potassium cyanide. The following are his main conclusions:—

(1) Various yellow and orange species of the Pieridæ rapidly become of a brilliant red when exposed to the action of "sloppy-solid" potassic cyanide.

* Comptes Rendus, cxv. (1892) pp. 958 and 9.

† Entomologist, Jan., March, and April, 1893, pp. 1–5.

‡ See Entomologist, 1891, pp. 163–7; and this Journal, 1891, p. 458.

(2) Faint indications of a similar nature are obtained by the use of sodium cyanide.

(3) No such reactions can be obtained with ferrocyanides, sulphocyanides, ammonium salts, nitrates, nor with other salts of potassium and sodium, nor with any of many other reagents examined.

(4) When exposed under similar conditions to the action of lithic sulphate, a fine purple-pink colour is produced, staining the salt. Similar, but more or less faint, results are obtained with several other reagents, including baric chloride, sodic arsenate, and succinic and salicylic acids. A reaction with zincic sulphate seems to be somewhat intermediate between (1) and (4).

(5) All of these reactions are confined to the Pieridæ, and are obtainable from no other yellow or chestnut Rhopalocera or Heterocera yet examined.

Oogenesis, Maturation, and Fertilization.* — Herr H. Henking makes further contributions of much importance to our knowledge of the early processes in the development of insect ova. His studies refer to *Pyrrhocoris apterus* L. and *Hydrometra Najus* Deg. among Hemiptera, *Agelastica alni* L. and *Donacia* (*sericea L. ?*), *Lampyris* (*Lamprorrhiza*) *splendidula* L., *Tenebrio molitor*, *Adimonia tanaceti* L., *Crioceris asparagi* L., *Lina aenea* L., *Gastroides polygoni* L. among Coleoptera, *Lasius niger* L., *Rhodites rosæ* L. among Hymenoptera, *Bombyx mori* L., *Leucoma salicis* L. among Lepidoptera, *Musca vomitaria* L. among Diptera. In regard to many of these types a wealth of detailed description is given, referring not only to oogenesis, polar body formation, fertilization, but, in some cases, to spermatogenesis, polyspermy, parthenogenesis, &c. We shall, however, restrict ourselves here to the general results.

The ova have three envelopes, (*a*) the vitelline membrane (oolemm), (*b*) the shell or chorion, perforated by micropyle or micropyles, and (*c*) a glandular secretion. Within the vitelline membrane is the superficial germinal blastem which is continued into a network through the yolk.

The germinal vesicle of the mature ovum disappears, leaving the chromosomata in a double row in the equatorial plate of the first directive spindle; in the subsequent formation of the first polar body there is a reduction in the number of chromosomata. While the two daughter-nucleus-plates go apart, the outer with the chromosomata of the first polar body, the inner with those of the *Spaltkern* or second directive spindle, there appears between them a (first) achromatic polar body, a "Thelyid," formed from the greater part of the substance of the connecting threads and of the cell-plate. This first Thelyid, which is sometimes like the young *Nebenkern* of a spermatide, is associated with the first polar body.

Without a resting stage the chromosomata of the *Spaltkern* divide, forming the second polar nucleus, whose formation may be associated with an "achromatic pseudospindle," often with distinct cell-plate,—*the second Thelyid* (*Agelastica, Lampyris, Pyrrhocoris*); or the halving of the chromosomata may occur without a separation of achromatic substance (*Pieris, Musca, Lasius, Rhodites, Tenebrio*).

* Zeitschr. f. Wiss. Zool., liv. (1892) pp. 1–274 (12 pls., 12 figs.).

The first polar nucleus may be extruded along with a little plasma (*Pyrrhocoris*, *Lampyris*); or a plasmic knob may be protruded, but not extruded, and may unite again with the ovum, the nucleus remaining undivided (*Tenebrio*) or dividing into two, both of which re-enter the ovum (*Agelastica*, *Adimonia*); or, thirdly, it may be that the first polar nucleus remains in the cortical plasma and there divides again (*Musca*, *Pieris*, *Bombyx*, *Lasius*, *Rhodites*). The second polar nucleus may be extruded (*Pyrrhocoris*, *Lampyris*), or it may be retained (except in the two last-named genera), but it does not redivide.

The chromosomata of the female pronucleus may retain their individuality, or they may fuse into a network. The first polar nucleus may remain undivided or it may divide. In the latter case there are four nuclei visible. Their transformations are compared.

It can rarely be said that a polar body is actually lost. Only in *Lampyris* does this seem likely. The second may unite with the inner half of the first, or the three may unite. The second Thelyid very soon disappears, the first may persist until fertilization is accomplished, and may be surrounded with plasmic radiations.

Henking accepts the conclusion that the first and second divisions of the spermatocytes are comparable to the divisions which form the first and second polar bodies. The ovum at the time of fertilization is relatively younger than the spermatozoon. Polyspermy is common, and does not seem to have evil effects. The head of the spermatozoon usually bends round towards the tail, and a clear substance near the bend is distinguished as the Arrhenoid; it seems to be connected with the tail, and to be comparable to the Thelyid. The gradual changes of the male nucleus are described. Vejdovsky's observations on *Rhynchelmis* are in remarkable accord with those of Henking.

The author proceeds to discuss different kinds of plasmic radiations, the history of the Thelyid, the formation of the segmentation nucleus, colourless nuclei, the number of chromosomata. He has a very interesting comparison of the processes of fertilization in Insects, Protozoa, and Angiosperms. The question of reducing-divisions, so important in connection with Weismann's "Amphimixis"; the observations of Ischikawa; the general problems of fertilization and heredity are also treated of. Henking does not depreciate the importance of the nucleus as a bearer of hereditary qualities, but he also believes in the importance of the plasma, and in the modifiability of the chromosomata by influences from the protoplasm.

Wings of Insects.*—Herr C. Hoffbauer has studied the wings of *Bombus lapidarius*, *Pontia cratægi*, *Colias brassicæ*, *Musca domestica*, *Chrysopa perla*, *Panorpa communis*, *Acridium grossum*, *Cimex rufipes*, and numerous Coleoptera. He has devoted his attention especially to the wing-covers and to the glands associated with them. The wing-covers are in structure very different from the posterior wings. The characteristic venation is absent, and the distribution of the tracheæ is quite different. In fact, the author is inclined to maintain that the wing-covers are homologous with the lateral lobes of the neck-shield. He finds corroboration in the Ephemerid *Prosopistoma*. On this supposition

* Zeitschr. f. Wiss. Zool., liv. (1892) pp. 579–630 (2 pls., 3 figs.).

there has been a reduction of the true membranous anterior wings of Coleoptera. It may be that alulæ and wing-covers of Dytiscidæ on the one hand, anterior wings and tegulæ of Hymenoptera on the other hand, have a common origin, and have arisen either by unequal growth from the first, or by subsequent reduction (in association with disuse) of both tegulæ and alulæ. The hypothesis would at least explain many difficulties.

Biological Import of Genital Appendages.* — Herr C. Escherich begins his essay with a general survey of the genital appendages in different orders of insects. He distinguishes in the males a primary part, the chitinous tube around the ductus ejaculatorius, from the secondary parts, protective and clasping. He describes uni-, bi-, tri-, and quadrivalvular forms of the copulatory apparatus. In the second part of his essay, the author shows how remarkably precise a criterion of species is furnished by the nature of the genital appendages. This is true of both sexes. In the third place he maintains that fertile sexual union can take place only between those forms whose genital appendages accurately correspond. Hybridism between different species seems mechanically impossible. The author does not think that the intricacies of the copulatory apparatus can be readily interpreted as adaptive. He invokes the aid of *das Princip der Reinerhaltung der Arten*. This, he believes, is the final cause; but the efficient cause is *ein unbekanntes Kraft*.

Dichogamy of Lepidoptera.†—Herr W. Petersen believes that the advantage of dichogamy lies in the prevention of in-breeding. He would call it, we know not why, "dichogennesis," and finds that it presents a striking analogy with dichogamy in plants! We should think that this was somewhat obvious. He believes that its occurrence may be readily accounted for by natural selection. The value of the paper is not in its biological considerations, which are commonplaces, but simply in its statement of the actual cases in which Lepidoptera are dichogamous.

Phylogeny of Papilionidæ.‡—Herr A. Spuler believes that Lepidoptera have arisen from forms resembling Neuroptera, and that they present in the structure of their wings a close resemblance to Trichoptera, though they are not derivable from any forms like those now living; nor are they of monophyletic origin. In ontogeny there is a uniform type of venation—the sub-imaginal stage. In regard to veins and scales, the species of *Thais* are more primitive than other Equitidæ. From *Thais*-like ancestors the main stem of Papilionidæ and Parnassiæ has arisen, and the Pieridæ also have had similar ancestors. In the Equitidæ (especially in the Rhopalocera, and certainly in many Heterocera) there are congruent markings on both pairs of wings, identical on both upper and lower surface, and referable to transverse unions of spots. In all Equitidæ the markings are traceable to one original type, though not necessarily to one original species. Herr Spuler has constructed a very elaborate genealogical tree.

* Verh. Zool.-Bot. Ges. Wien, xlii. (1892) pp. 225-39 (1 pl.).
† Zool. Jahrb., vi. (1892) pp. 671-9. ‡ Tom. cit., pp. 465-98 (2 pls.).

Fauna of British India.—The preceding volumes of this series * have dealt exclusively with the Vertebrata; of the immense field entered on by commencing to classify and describe the Invertebrata of British India and Ceylon, some idea can be formed by the fact that in Moths alone at least 5000 species have to be dealt with.

The part of Mr. G. F. Hampson's present volume that is of interest to others than those who devote themselves specially to the study of Oriental Heterocera is the scheme of classification and synopsis of the families. It is almost needless to say that this in the main follows the admirable system evolved by Lederer and Herrick Schäffer. Yet many new elements are introduced, especially the use of vein 5 of the fore-wing as a primary character for the division of all the families into three groups.

In the first group this vein is given off from the centre of the cell, and the Saturniidæ are taken first as being the most specialized family, the series being carried down through the Eupterotidæ, Sphingidæ, Uraniidæ, Geometridæ and others, to the Notodontidæ and Cymatophoridæ. The two last families are unquestionably the lowest of the group, though it is doubtful if their ancestor sprang from some Noctuid form of the second group, of which *Cyphanta* is the nearest living representative, or, lower still, from some reed-boring form which would also have been the ancestor of the *Pyrals* and closely allied to the Cossidæ, most nearly represented by the S. American *Myelobia*.

The second group, in which vein 5 of the fore-wing is given off from the lower angle of cell, is regarded as divisible into four subsidiary groups of families, for the distinctions between which recourse must be had to the volume itself. To the first of these belong the Syntomidæ, Zygænidæ, Cossidæ, Arbelidæ, Psychidæ, and, lowest of all, the Hepialidæ, with their twelve veins to the hind-wing, as in the fore-wing: to the second, the Limacodidæ and Lasiocampidæ: to the third, the Pterothyranidæ, Lymantriidæ, Hypsidæ, Arctiidæ, Agaristidæ, and Noctuidæ: to the fourth, the Callidulidæ, Drepanulidæ, Thyrididæ, and Pyralidæ.

The third group, which is without doubt the lowest in the scale, and from some of the primitive forms of which the other two have sprung, is characterized by the veins of the fore-wing being given off at almost equal distances round the cell, being thus nearest the still more primitive form in which the veins all radiated from the base of the wing before the anastomosis of their basal portions formed the cell and present branching system of veins; this form is still represented in almost its primitive state, both as to neuration and structure of mouth-parts, by the lower Micropterygidæ, which can hardly be differentiated from some forms of Neuroptera. In this group are placed the Sesiidæ, Tinægeriidæ, the Tineidæ, in its larger sense as including the Tortricinæ, and, lastly, the Pterophoridæ and Alucitidæ.

Caterpillars Living in Water.†—Dr. G. W. Müller describes the aquatic caterpillars of *Hydrocampa nymphæata* and *Cataclysta lemnæ*, and of two other species of *Cataclysta*, and one of *Paraponyx* from Brazil. The caterpillars of *Hydrocampa nymphæata* are unique in that they

* 'The Fauna of British India—Moths,' by G. F. Hampson, vol. i. London, 1892, 8vo, 527 pp., 333 figs. † Zool. Jahrb., vi. (1892) pp. 617–30 (1 pl.).

breathe through their skin during the first part of their larval life, while during the second period they breathe by stigmata. In *Paraponyx* sp. the leaf-walls of the caterpillar's case give off oxygen, which is utilized; it is likely that the same is true of *Hydrocampa* and *Cataclysta*. In the pupæ of the above-mentioned forms the stigmata of the second and third or second and fourth abdominal segments are much protruded, and are alone open. The pupæ are enveloped in a white, air-containing cocoon, between which and the external medium there is gaseous interchange. Without this mediating cocoon the pupæ soon die in the water.

Secretion of Potassium Hydroxide by Dicranura vinula.*—Mr. O. H. Latter has investigated the means by which the imago succeeds in piercing the exceedingly hard cocoon formed by the larva of *D. vinula*. He finds that it produces, probably from the mouth, a solution of potassium hydroxide, by which it softens the cocoon. The labium of the wings is provided with two sharply pointed processes, which are used for scraping the inner surface of the cocoon; the eyes and median portion of the head of the pupa are retained as a protecting shield over the same structures of the imago until emergence is completed.

Aglia tau.†—Prof. A. S. Packard looks on this Bombycine moth as a connecting link between the Ceratocampidæ and Saturniidæ, and as the type of a new subfamily Agliinæ. He thinks it quite reasonable to suppose that the Saturnians are directly descended from a form like *Aglia*, and that we could scarcely expect a clearer demonstration of the origin of one family from another by direct genetic descent. He gives detailed reasons for these views.

Sensory Nature of "Appendix" of Antennæ of Coleopterous Larvæ.‡—Mr. C. J. Gahan brings forward evidence to favour the view that the structure on the distal surface of the penultimate segment of the antennæ of many larval Coleoptera, which has been called "appendix" and by various other names, is of a sensory nature. When that of the Carabid genus *Pterostichus* is examined under the Microscope, it is seen to consist of a short stalk, which supports a cap composed of a thin transparent cuticular membrane, which appears to be lined by very small cells. The cap has the form of a short cone with curved sides, and has as its base a narrow and thickened chitinous ring. Within the laterally expanded distal portion of the third segment there appears to be a ganglionic swelling of the antennary nerve, from which fibres or rods were seen to extend into the collar.

Although auditory rods have not yet been seen, the author thinks that, from its position and from the way in which it is guarded by long, stiff setæ, as well as from its general structure, this hitherto somewhat neglected "appendix" will be shown to be an auditory nerve.

Biological Notes on Hymenoptera.§—Herr C. Verhoeff begins by pointing out that if we would understand the colonies of wasps and bees, we must learn more about the Fossoria. He classifies and describes the

* Trans. Entomol. Soc. Lond., 1892, pp. 287–92 (4 figs.).
† Ann. and Mag. Nat. Hist., xi. (1893) pp. 172–5.
‡ Tom. cit., pp. 154–6.
§ Zool. Jahrb., vi. (1892) pp. 680–754 (2 pls.).

nests from the simple "monœcia," through "orthœcia," "dendrœcia," "eleutherœcia," and "trogloecia," to "melissœcia." Then follow interesting observations on individual species, a mine of information on nests, cocoons, nutrition, and reproduction. He finds hints as to the evolution of wasp colonization and architecture in *Odynerus* and *Holopus*, while *Halictus* is not less significant in relation to bees. The three primary conditions of colonial life are—(1) a space which will shelter a large number, (2) a close approximation of the cells which the mother makes, and (3) that the first offspring are hatched while the mother is still occupied with the youngest. The difference between the life of wasps and bees depends fundamentally on the difference of nutrition. This is ingeniously followed out. Herr Verhoeff also describes the different kinds of cocoon, the different ways in which the cells are closed, and the various enemies of the wasps and bees. This paper, like others by the same author, is full of interest to the general biologist.

Sounds made by Ants.*— Herr E. Wasmann notes that further evidence is forthcoming in regard to the powers ants have of producing sounds. This evidence increases the probability that they also hear. He quotes from R. Wroughton † in regard to the "hissing" of *Crematogaster Rogenhoferi*, believed, but not proved, to be due to individual stridulation. Mr. Wroughton quotes from Mr. Aitken: "The roar raised by a squadron of Lobopelta, if you poke at them with a straw, does not require to be listened for with your hand to your ear!" Wasmann has confirmed Forel's observation as to the "alarm-signal" made by *Camponotus ligniperdus*. He points out that this may be felt rather than heard by the ants. A slight chirping noise made by an excited crowd of *Myrmica ruginodis* in a glass vessel seemed to be due to a violent movement of the abdomen. The author also directs attention to the stridulation of *Myrmica ruginodis* observed by Mr. A. H. Swinton.‡

Tibial Auditory Apparatus of Locustidæ.§—Herr N. von Adelung has studied this in *Locusta viridissima* L., *Decticus verrucivorus* L., *D. griseus* Fabr., *Thamnotrizon apterus* Fabr., and *Meconema varium* Fabr. On each side of the tibia lies a tympanum, usually covered by a duplicature of the integument, which narrows the communication with the outer world to a cleft. Internally there is an auditory ridge (*crista acustica* of Hensen), a supra-tympanal organ, and a specially differentiated proximal part of the auditory ridge which the author calls the intermediate organ (*Zwischenorgan*). Each part has its nerve-endings, which are described; a distinct nerve supplies one group of the terminal tubules of the supra-tympanal organ, another supplies a second group of the terminal tubules of the supra-tympanal organ, and the terminal organs of the crista and its proximal differentiation. Each end organ encloses distally a conical *Gehörstift* which forms the proper nerve-ending. The minute structure of the crista and the "intermediate organ" is described, but without the figures the complex histology can scarcely be understood. It is interesting to notice that the author

* Biol. Centralbl., xiii. (1893) pp. 39–40.
† Journ. Bombay Nat. Hist. Soc., 1892, p. 15.
‡ Entomol. Mon. Mag., xiv. (1878–9) p. 187.
§ Zeitschr. f. Wiss. Zool., liv. (1892) pp. 316–49 (2 pls., 1 fig.).

believes the end-organs of the "intermediate organ" are distally connected with the integument, and that there is thus a transition towards the chordotonal organs. In regard to the supra-tympanal organ the most important general result appears to be the fact that it includes two distinct groups of terminal tubules, and that the group innervated by a distinct supra-tympanal nerve is independent of the others.

Histology of Organs Appended to Male Apparatus of Periplaneta orientalis.*—M. P. Blatter finds that the seminal vesicles of this insect have a delicate external membrane which stains deeply, and contains small fusiform nuclei. With high powers and longitudinal sections the structure of the membrane is seen to be fibrillar; the fibrils are exceedingly delicate and are grouped in intercrossing bundles. The epithelium of the vesicles is formed by large cells with dense protoplasm and large nuclei rich in chromatin. Most of the seminal vesicles are filled by a viscous liquid which is rich in fat-globules, and which clearly serves to dilute the sperm at the time of copulation.

The wall of the ejaculatory canal is formed, externally, of a rather thick layer of striated muscular fibres, most of which are disposed circularly; the musculature is lined by an epithelial coat, which is supported by an excessively delicate membrane, and which exhibits certain differentiations in various regions. Throughout its length it is covered by a chitinous membrane which, in places, carries a number of setæ.

β. Myriopoda.

Myriopoda of the 'Challenger' Expedition.†—Mr. R. I. Pocock gives a systematic account of the Myriopoda collected during the voyage of H.M.S. 'Challenger,' in the course of which he describes a number of new species. With regard to those which are found in Bermuda, Mr. Pocock points out that of the ten known species, four have doubtless been introduced from the West Indies, three are either of Palæarctic or Nearctic origin, while the remaining three unquestionably belong to the Mediterranean fauna of the Palæarctic region.

New Mode of Respiration in Myriopoda.‡—Mr. F. G. Sinclair has published in full an account of his observations on the respiratory organs of the Scutigeridæ, an abstract of which has already been noted in this Journal.§ He is of opinion that these observations confirm strongly the views of Sedgwick as to tracheæ having been at first simple pits which gradually became more complicated, and that a special localization of tracheæ is found in the pulmonary sacs of Scorpions. Mr. Sinclair thinks that the organ of *Scutigera* is intermediate between the simple tracheæ and the lungs of Spiders.

γ. Prototracheata.

Viviparity of Australian Peripatus.‖—The discussion between Mr. J. J. Fletcher and Dr. A. Dendy may now, we imagine, be considered to have come to an end. Mr. Fletcher deals in a severe and

* Comptes Rendus, cxv. (1892) pp. 1332–4.
† Ann. and Mag. Nat. Hist., xi. (1893) pp. 121–42 (1 pl.).
‡ Phil. Trans., 183 B (1893) pp. 61–72. § 1892, p. 36.
‖ Proc. Linn. Soc. N.S.W., vii. (1892) pp. 179–96.

sarcastic manner with Dr. Dendy's assertion that *Peripatus leuckarti* is oviparous, and brings abundant evidence to show that the species from New South Wales, which bears that name, is viviparous. Dr. Dendy * accepts this evidence but reiterates his assertion that the species which bears the same name in Victoria is oviparous, and he brings forward some fresh evidence in support of his assertion. Dr. Dendy points out that it was in deference to the judgment of others that he called the Victorian species *P. leuckarti*, and he refrains at present from giving a new specific name to the cause of a very lively discussion.

δ. Arachnida.

Morphology and Classification of Arachnida.†—Mr. R. I. Pocock proposes to divide the Arachnida into two sub-classes—that of the Ctenophora, and that of the Lipoctena. In the former the embryo is provided with six pairs of abdominal appendages, the second of which persists in the adult as the pectines; in the latter the embryo is not provided with more than four pairs of abdominal appendages, and the second are never retained as external organs in the adult. The Ctenophora, of which the Scorpiones form the sole order, have, in the adult, four pairs of abdominal breathing organs in the form of lamellar tracheæ, the abdomen is very long, the foot and sclerite has two poison-glands, and they are viviparous. The Lipoctena, on the other hand, have not more than two pairs of abdominal breathing organs, the abdomen is much shorter, there are no post-anal poison-glands, and they are usually oviparous. The second sub-class is divided into two main groups distinguished by the first having the cephalothorax and abdomen separated by a deep constriction, the first abdominal sternite forms an operculum to the respiratory stigmata, and the breathing organs are lamellar tracheæ; the first two of these characters are not seen in the second division, where, also, the tracheæ are tubular. This first subdivision is called that of the Caulogastra, and contains as orders the Pedipalpi and the Araneæ. The second subdivision falls into two groups, that of the Mycetophora (order Solifugæ), in which there is a pair of respiratory stigmata between the fourth and fifth cephalothoracic appendages, and that of the Holosomata (orders Pseudoscorpiones, Opiliones, and Acari), in which there are no such stigmata, and the cephalothorax is covered by a continuous shield.

After a few remarks on the classifications of Profs. Lankester and Thorell, the author examines the question whether any beneficial results can be ascribed to the structural modifications which he has traced through the Arachnida, from the Scorpiones to the Acari. Mr. Pocock thinks there is evidence that the replacement of pulmonary sacs by tracheæ has taken place independently at least twice—once in the Dipneumonous Spiders, and once in e. g. the Pseudoscorpiones. This fact is of weight as weakening the evidence of the affinity between the Opiliones and the Pseudoscorpiones. The fact, at any rate, that these tubes have been developed twice in the same group bears very strong evidence as to their efficacy as breathing-organs; they must be supposed to be better adapted for their purpose than lung-book tracheæ, and it is suggested that an

* Proc. Linn. Soc. N.S.W., vii. (1892) pp. 267–76.
† Ann. and Mag. Nat. Hist., xi. (1893) pp. 1–19 (2 pls.).

Arachnid furnished with tracheal tubes, such as *Galeodes*, must be considerably lighter, and consequently more agile than one which, like the Scorpion, possesses pulmonary sacs.

Terminal Organ of Pedipalp of Galeodes.*—Mr. H. M. Bernard takes the view of Koch that this organ is sensory, against that of Dufour, its discoverer, that it is a sucker-like seizing organ. The organ itself forms a conical pit the dorsal wall of which is thickly covered with fine sensory hairs, so regularly arranged that the chitinous membrane from which they arise appears like a fine network. The hairs are in evident connection with a deep sensory epithelium. A very similar organ, lately discovered on the pedipalps of *Phrynus*, clenches the argument in favour of the sensory function of this organ; in it a sensory area runs longitudinally along about half the length of the claw. Further histological details are reserved for the present, and it is suggested as a point well worth investigating whether the peculiar sexual organs at the end of the pedipalp of Araneids had any original connection with such a sensory organ.

Reproductive Organs of Galeodes.†—Herr A. Birula has investigated *Galeodes araneoides* Pall. and *G. ater* Bir. As to the male, the genital aperture is a longitudinal cleft on the posterior margin of the first abdominal segment; there are acinose glands opening into the uterus masculinus which is lined with chitin; the vasa deferentia divide in the third abdominal segment into two branches narrowing towards the filiform testes; on the walls of each vas deferens as they enter the uterus masculinus there are accessory acinose glands; at sexual maturity the end of each branch of the vasa deferentia expands into a vesicula seminalis; the testes consist of four coiled tubes, which before entering the vesiculæ seminales become glandular and secrete the membrane of the oval, somewhat flattened, spermatophores which pass into the female.

As to the female, the external aperture is as in the male; the vagina is lined by a chitinous intima; the receptacula seminis are paired vesicles, lined by chitin, and opening into the vagina; the uterus has two ear-like posterior appendages; the oviduct passes directly into the ovaries; the ova develope from an epithelial layer on the external wall of the ovaries; the ripe ova lie in protruding follicles; in the cavity of the ovaries and oviducts there are free amœboid cells which destroy the sheath of the spermatophores, liberate the spermatozoa, and destroy those which are superfluous; the ova develope within the cavity of the ovaries; there are no embryonic membranes; the thoracic and abdominal segments are distinguishable before there are rudiments of appendages; there is a rolling up of the embryos as in Araneina; the lateral organs, described by Croneberg, occur as long vesicular sacs bound to the body by thin stalks over the first pair of appendages; in the hatched offspring they are already much reduced; in the adult their remains are probably to be found in triangular tongue-shaped folds lying under the mandibles.

* Ann. and Mag. Nat. Hist., xi. (1893) pp. 28–30.
† Biol. Centralbl., xii. (1892) pp. 687–9.

Eye of Phalangiidæ.*—Mr. F. Purcell finds from his investigation of *Leiobanum hemisphæricum* that the eyes of Phalangiidæ are compound eyes. The retinal cells are arranged in groups. Each of these retinulæ consists of four cells, one central and three peripheral. The strongly refractive rods of the four cells lie at the distal end and fuse in one triradiate rhabdome. The original eye-fold, the formation of two eye-pockets, and the development of these pockets into eyes, are briefly described. A thickening of external epithelium over the pockets forms the vitreous body; the lens arises at the first ecdysis as a cuticular product of the same epithelium; the outer wall of the pockets becomes the retina; the fate of the inner wall was not precisely observed. The eyes of Phalangiidæ are thus inverse eyes, homologous with the anterior middle eyes of spiders and with the middle eyes of scorpions.

Nerve-Ganglion in Legs of Phalangium opilio.†—M. Gaubert points out that while the parts of limbs of Crabs and Spiders detached by autotomy remain motionless and in a state of contraction those of *Phalangium opilio* exhibit for some minutes convulsive movements; the movements are ascribed to a ganglion which is to be found on the pedal nerve at a point in the third joint of the leg where the trunk gives off a nerve-branch; the movements are not, therefore, as the author first supposed, due to direct stimulation of the nerve. When the leg is quite uninjured the ganglion in question is probably under the influence of the superior centres which correspond to the thoracic ganglia.

Types of Larvæ among Freshwater Mites.‡—Prof. P. Kramer describes three chief forms:—(1) the larva of *Hydrachna* C. L. Koch; (2) the larva of *Nesæa* C. L. Koch (also *Piona*, *Atax*, *Hygrobates*, &c.); (3*a*) the larva of *Diplodontus filipes* Dug. (also *Hydrodroma*); (3*b*) the larva of *Eylaïs extendens*. There is much reason to regard *Diplodontus*, *Hydrodroma*, *Eylaïs*, and perhaps also *Limnochares* and *Bradybates*, as descendants of Trombidiidæ. The author thinks that there must have been several migrations of "Prostigmata" from the land into the fresh water; the latest migration of Trombidiidæ is not ancient enough to have become associated with deep modifications of the larvæ, thus we have those of *Diplodontus*, *Hydrodroma*, *Eylaïs*, *Limnochares*, adapted for terrestrial rather than for aquatic life; a much more ancient migration led to such types as *Hydrachna* and *Nesæa* whose larvæ are genuinely aquatic. Kramer upholds his order of Prostigmata, which includes Hydrachnidæ, Eylaïdæ, Hygrobatidæ, and Trombidiidæ.

Chernes on a Tipulid.§—Dr. F. von Wagner describes the case of a Tipulid (*Ctenophora pectinicornis*) on the legs of which Herr H. Friese found four blind Pseudoscorpionidæ of the genus *Chernes* (*Ch. Hahnii*). He thinks it likely that the *Chernes* simply utilizes the fly as a means of transport.

Peculiar Parasite of the Goura.‖—Dr. L. Karpelles describes a peculiar cutaneous and subcutaneous parasite which seems to have

* Zool. Anzeig., xv. (1892) pp. 461–5 (3 figs.).
† Comptes Rendus, cxv. (1892) pp. 960 and 1.
‡ Arch. f. Naturg., lix. (1893) pp. 1–24 (1 pl.).
§ Zool. Anzeig., xv. (1892) pp. 434–6 (2 figs.).
‖ Verhandl. Zool.-Bot. Gesell. Wien, xlii. (1892) pp. 46–7.

caused the death of a goura. The animal was white, 2–3 mm. in length, cylindrical in shape, with four pairs of appendages, but without any mouth-organs, in fact without any mouth. The form of the body suggests *Phytoptus* and *Demodex*, the feet and the epimera remind one of *Analges*. As feathers and epidermis were uninjured the "mite" cannot have made its way in from outside.

ε. Crustacea.

Influence of Light on Coloration of Crustaceans.*—M. A. E. Malard points out that the influence of light on the coloration of Crustaceans, which is enormous, may be effected in two different ways; chemically, that is by the modification of a pigment under the direct influence of light, or physiologically by the action of chromatoblasts working indirectly under the influence of light, and by the intervention of a sort of reflex process which actually originates from the eyes of the animal. Recalling the observations of many naturalists and his own, the author concludes that concealment by isochromatic adaptation seems to be very common among Crustacea, and that albinism is only a particular case of a very much more general phenomenon of chromatic adaptation to environment.

Ganglionic Lamina of Palinurus.†—Under the general title of a contribution to the histology of the nervous system of Invertebrates, M. H. Viallanes here deals with one subject only; he finds it necessary to take parts in detail, as he is of opinion that Dr. Nansen has generalized too widely from insufficient data. The lamina here dealt with forms a delicate hemispheral cup between the basal membrane of the eye and the external medullary mass of the optic ganglion. He finds it to be composed of a large number of small organs, each of which corresponds to an ommatidium, and which therefore he designates as "neurommatidia." This last is a mass of protoplasm of areolar structure, and has the same histo-chemical reactions as the protoplasm of the ganglionic cells; it is traversed by seven cylinder-axes which come from the corresponding ommatidium, which pass on to the deeper parts of the optic ganglia. Between the neurommatidia, but not uniting directly with them, there circulate the branches of a rich nervous plexus; from this fibres are given off which pass to the deeper centres.

With regard to the function of these parts the author suggests that the seven cylinder-axes which traverse the neurommatidium act by induction on the protoplasmic substance which forms it. The substance of this last acts in its turn, by induction, on the fibres of the plexus, and thus gives rise to nerve-currents.

Absorption in the Crayfish.‡—M. C. de Saint-Hilaire finds that the pancreas (so-called liver of earlier authors) of the Crayfish has the function of excreting certain anilin colours, when these are injected into the blood. This is probably effected by the tubes of the pancreas absorbing the colouring matters by their blind ends; after this absorp-

* Bull. Soc. Philom. Paris, iv. (1892) pp. 24–30. See Ann. and Mag. Nat. Hist., xi. (1893) pp. 142–9.
† Ann. Sci. Nat., xiii. (1892) pp. 385–98 (1 pl.).
‡ Bull. Ac. Roy. Belgique, lxii. (1892) pp. 506–16.

tion the cells, which were called by Frenzel the fermentative cells, become coloured; some time after injection these cells have been found in the gastric juices and in the intestine. Some colouring matters introduced into the intestine do, and others do not, pass through the intestine. If a crayfish be examined immediately after an injection has been made into the anus, it will be found that the colour has penetrated into the tubes of the pancreas. Carmine and indigo-carmine are not absorbed by the cells, but become massed in the form of granules, and these granules are enveloped by a delicate membrane. Methyl-blue is absorbed in considerable quantity by the cells, but the author thinks that it does not penetrate into the body of the animal. He has attempted to put the tubes of the pancreas into physiological salt solution with methyl-blue, but he never obtained the same kind of coloration as in the living Crayfish; this coloration may be shown to depend on the vital activity of the cells. If a crayfish in which methyl-blue has been injected be left untouched the colour disappears after death, and the pancreas becomes brown. On examination, however, the surface of the organs becomes, after some time, blue, on account of the oxidation produced by the oxygen of the air.

The author has made some experiments with peptones, and he is led to the conclusion that, if the pancreas is a digestive gland, it has also an excretory and perhaps an absorbent function. At any rate, digested food passes into its tubes, and it is not possible to prove that absorption takes place in the intestine.

Hippa emerita.*—Dr. B. Sharp explains the mistake some writers have made in saying that this animal burrows head forwards, by explaining that the posterior pair of thoracic feet are bent upwards over the posterior part of the carapace, and resemble, on superficial observation, antennæ. For this reason the posterior part of the body has been taken for the anterior. The posterior feet of this crustacean are employed in loosening the sand, while the other limbs push the animal backward into it; this mode of progression is more or less common to all Decapods. To preserve the colours of the animal Dr. Sharp recommends that they be placed, while yet alive, in a 50 per cent. solution of corrosive sublimate, and left in it for two days; after this they should be washed in pure water and dried.

Development of Germ-stripe of Mysis.†—Dr. R. S. Bergh finds that the cells of the transverse stripe which appears early in the blastoderm of *Mysis* soon become (1) wandering vitellophages, (2) elements of the enteric endoderm, or (3) primitive cells of the muscle-plates (mesoderm of authors). As soon as four of these last have appeared on either side they commence to give rise by budding to smaller cells; as growth goes on, the muscle-plates become distinctly segmented, and the author does not doubt but that the segments into which they fall are primitive segments. The muscle-plates do not form a continuous layer until these segments fuse with one another.

The ingrowth which gives rise to the deeper cell-layers corresponds to the gastrular invagination, but it cannot be definitely asserted whether

* Proc. Acad. Nat. Sci. Philad., 1892, pp. 327–8.
† Zool. Anzeig., xv. (1892) pp. 436–40.

the muscle-plates are genetically connected with the ectoderm or with the endoderm. The blastopore has no relation whatever to the mouth or to the anus.

At the anterior edge of the blastopore there is a very peculiar differentiation of some of the ectoderm cells; seventeen or nineteen rapidly form a transverse curved band in front of the blastopore, and then give rise by budding to smaller cells. In this way there is formed an ectodermal germ-stripe, formed of seventeen or nineteen rows of cells. This band extends forwards as far as a line which unites the points of insertion of the right and left mandibles with one another. In front of this line there is a mosaic of polygonal ectodermal cells. The ventral ectoderm, it is of interest to observe, becomes differentiated into a naupliar and a "metanaupliar" rudiment; the naupliar appendages grow out from the anterior cell-mosaic, while all the appendages behind the mandibles owe their origin to the germ-stripes derived from the primitive cells. Behind these last there is, at an early stage, an embryonic (provisional) forked tail-fin, which is very distinct in the nauplius-stage.

The history of the ganglionic cells is not unlike that of Insects, as described by Wheeler, but in *Mysis*, the neuroplasts are not overgrown by epidermis, but form always the most superficial cellular layer in their own region. There are in the history marked points both of agreement with and divergence from that of *Gammarus*.

Structure of Cypridæ.*—Prof. C. Claus gives a general account of the structure of Cypridæ, describing the position of organs, the shell, the antennæ, the upper lip, hypostome, and mouth-parts, the legs and furcal pieces. Some new facts are added, some old statements are corrected. Diagnoses and descriptions are given of some South American forms—the genus *Acanthocypris* Cls., the species *A. bicuspis* Cls., the genus *Pachycypris* Cls., and two new species *P. Leuckarti* and *P. incisa*.

The Genus Copilia (Sapphirinella).†—Dr. F. Dahl gives the specific diagnosis, synonymy, and distribution of *Copilia mirabilis* Dana, *C. mediterranea* Claus, *C. lata* Giesbr., *C. quadrata* Dana, and *C. vitrea* Hæckel. He gives tables showing the occurrence and the characters of the males and females, for in this genus, as is well known, there is marked sexual dimorphism. The species occur only in the tropical and subtropical regions. In the Atlantic the region of currents is much richer than the Sargasso Sea and the region between Ascension and Brazil. Two species, *C. lata* and *C. vitrea*, occur almost uniformly distributed; *C. mediterranea* is not found south of Cape Verde; *C. mirabilis* is absent from the Sargasso Sea and the north-east region; *C. quadrata* was not found in the south-west, but was abundant between Cape Verde and Ascension and in other parts. All are very rare, if not absent, at depths below 700 metres.

Vermes.

a. Annelida.

Asymmetrical Growth in Polychæta.‡—M. de Saint-Josephs has observed that, in many species of Sabellidæ, the number of thoracic

* Arbeit. Zool. Inst. Univ. Wien (Claus) x. (1892) pp. 147–216 (12 pls., 3 figs.).
† Zool. Jahrb., vi. (1892) pp. 499–522 (1 pl.).
‡ Comptes Rendus, cxv. (1892) pp. 887–90.

segments is not equal on the two sides of the body of one and the same individual. This want of symmetry is very common in *Bispira volutacornis;* common in *Sabella pavonina*, and less common in *Branchiomma vesiculosum* and *Dasychone bombyx*. At present the author is content to signalize the facts without waiting for the law which governs them; but they are so numerous, and proportionately so common that it is impossible to consider them as anomalies. It is very probable that examples of asymmetrical growth will be found, on search, in many other families of the Polychæta.

Alciopidæ of Messina.*—Prof. E. Hering gives an account, with many anatomical details, of seven species of *Alciopa*. He recognizes two well-marked groups; in one the worms are colourless and transparent, while the tentacles and cirri are less developed than in other groups, where the body is less transparent and sometimes of a yellowish colour. Some additions are made to the earlier synonymy.

Nephridiopores of Earthworms.†—Prof. A. A. W. Hubrecht having observed considerable differences in the position of the nephridiopore of *Lumbricus* and *Allolobophora*, and learnt that Claparède and Borelli had already called attention to the variations, gives some account of his own observations. He is able to confirm the statement of Borelli that in one and the same individual the nephridiopores may lie just above the second seta, just above the fourth seta, or in the space between the fourth seta and the dorsal pore.

With regard to the significance of these facts as bearing on the archaic condition of the nephridia in earthworms, Prof. Hubrecht points out that Beddard and Spencer have accepted the view, to which Benham inclines, that the "plectonephric" arrangement of the nephridia is the more archaic, while Ray Lankester and Horst think that the "meganephric" arrangement is the older of the two.

The author urges that the inconstancy in the position of the nephridiopores is an argument in favour of the hypothesis that two (or perhaps even three) pairs of large nephridia were originally contained in each segment, and that of these two pairs one had its nephridiopore above the outer, the other above the inner couple of setæ. He urges more competent specialists to test his views in different genera, and points out the support which the facts adduced give to the suggestion made by Lankester in 1865 that nephridia might be adapted to the service of the generative system.

Nephridia of Megascolides.‡—Prof. F. Vejdovsky has studied the development of the nephridial system in *Megascolides australis*. The youngest embryo, sent to him by Prof. Baldwin Spencer, was 36 mm. in length, obviously too old to show the beginnings of the nephridial apparatus. In the hindmost segments the præseptal funnel rudiment was seen passing into the postseptal strand which ran along the dissepiment to the dorsal line, and ended with a simple coil. The funnel-rudiment did not show any canal or cilia, the postseptal strand and the dorsal coil were also solid. In the segment in front, the dorsal coil

* SB. K. Akad. Wiss. Wien, ci. (1892) pp. 713–68 (6 pls.).
† Tijdschr. Nederl. Dierk. Vereen., iii. (1892) pp. 226-34 (1 pl.).
‡ Arch. f. Mikr. Anat., xl. (1892) pp. 552–62 (1 pl.).

thickened, and further forward the loops began to appear. Vejdovsky goes on to describe how the original epithelial strand gradually degenerates into connective tissue and disappears, and how the micronephridia are differentiated from the original *Mutterstrang*. The micronephridia have no nephridiostomes; their efferent ducts are intercellular; of longitudinal canals there is in young forms no trace; nor were any meganephridia found; the funnel rudiments originally present in each segment suffer degeneration except apparently in the most posterior segments where meganephridia appear. The micro-nephridia are not to be regarded as primary, but the meganephridia are specialized structures, both derived from a common nephridial strand, which in its simplest form is comparable to the pronephridium of *Rhynchelmis*.

New Genera and Species of Earthworms.*—Mr. F. E. Beddard commences with a description of *Polytoreutus magilensis* from Magila, East Central Africa; one individual was 14½ inches long; especial attention is directed to the male generative apparatus; there is an immense number of spermatophores, and this is, perhaps, the cause of the enormous development of the sperm-holding apparatus. The new genus and species, *Trichochæta hesperidum*, is founded on a single example of an earthworm from Jamaica; it is one of the Geoscolicidæ, which family, as now emended, consists of the author's two families Urochætidæ and Geoscolicidæ, minus *Hormogaster* and *Glyphidrilus*, but inclusive of *Urobenus*, *Rhinodrilus*, and *Anteus*. The forms included in it agree in having one to four pairs of spermatothecæ, placed in the neighbourhood of the gizzard, and in wanting copulatory papillæ. The constituents are, with the exception of the ubiquitous *Pontoscolex*, confined to the New World. The next family, or that of the Microchætidæ, has the spermatothecæ usually as many small pouches in a segment, placed in the neighbourhood of the ovaries, while copulatory papillæ are present in nearly every case; the six genera, known to belong to this family, are natives of the tropical parts of the Old World. *Pygmæodrilus lacuum* sp. n. was found at Lagos, West Africa. Further notes are offered on the structure of *Siphonogaster Millsoni*, and the genus is said to belong to the family Geoscolicidæ.

The author concludes with an account of a new genus which he calls *Alvania* (*A. Millsoni* sp. n.) from Lagos; it is one of the Eudrilidæ, and is most closely allied to *Heliodrilus*. It agrees with *Paradrilus* in having no true spermatotheca, but only a cœlomic pouch which discharges the functions which in other earthworms are performed by the spermatothecæ.

Japanese Perichætidæ.†—Mr. F. E. Beddard has notes on four Japanese species of *Perichæta*, three of which are new; the species of this genus found in Japan have certain peculiarities; none have setæ on the clitellar segments; in several there is a tendency for the atria to disappear, and in *P. rokugo* sp. n. no trace is left; this character is a step in the direction of the Geoscolicidæ; there is generally only one pair of receptacula ovorum, and the situation they occupy—in segment xiii.—is most unusual, when there is but a single pair.

* Quart. Journ. Micr. Sci., xxxiv. (1893) pp. 243–78 (2 pls.).
† Zool. Jahrb. (Abth Syst.) vi. (1892) pp. 755–66 (1 pl.).

New Perichætidæ.*—Dr. D. Rosa describes from Sig. L. Fea's collection of Perichætidæ from Burmah a number of new species, viz. *Perichæta carinensis*, *P. Bournei*, *P. Peguana*, *P. campanulata*, *Perionyx arboricola*.

New Earthworm from Ireland.†—The Rev. H. Friend describes a new earthworm from Dublin, which he calls *Allolobophora hibernica;* when extended it is about 50 mm. long, and, in colour, most closely resembles *A. mucosa*, but the setæ are in eight distinct rows. Mr. Friend learns from Dr. Rosa, of Turin, that he has lately found the same species in Italy.

New Oligochæte.‡—Mr. E. S. Goodrich describes a new Tubificid which he found on the seashore at Weymouth last August. To the naked eye it is quite indistinguishable from *Heterochæta costata;* the whole surface of the body is clothed with a dense covering of fine "hairs" or "bristles," which are probably sensory. The blood is crimson, and a large number of round corpuscles float in the cœlomic fluid. The most remarkable characters are exhibited by the genital system. On the anterior wall of the tenth segment are situated the paired testes, and in this segment the two funnels of the sperm-ducts open. These ducts are short convoluted tubes with thick glandular walls for the greater part of their course; they open into a median atrium, which appears to be formed by an invagination of the epidermis, and is of considerable size. The ovaries are found on the anterior wall of the eleventh segment, and their ducts are short tubes, which open on the twelfth segment. On the tenth segment there are two pear-shaped spermathecæ.

The author proposes to name this worm, of which he hopes to shortly give a detailed account, *Vermiculus pilosus*, justifying the formation of a new genus on the possession of median male and spermathecal pores, and a covering of fine "bristles."

New Naidomorpha.§—Dr. C. Floericke has a few preliminary notes on what seem to be new species or varieties of Naidomorpha:—A species of *Nais* which is midway between *N. elinguis* Müll. and *N. barbata* Müll.; a species of *Ophidonais* differing from *O. serpentina* Oerst. in its smaller size and unswollen setæ; three species of a subgenus, intermediate between *Stylaria* and *Pristina*.

Glossiphonia tesselata in Chili.‖—Dr. R. Blanchard states that he received a small leech said to have been found on a specimen of *Myotopamus Coypu* mortally wounded in the "Lagune de Cauquenes." He was astonished to find that it was the well-known leech of Northern Europe, first described by O. F. Müller. Four means are suggested by which the creature may have reached South America; it might have passed to North America on some Palmiped, or by *Calidris* or *Tringa*, or it may have been transported by some domestic animal, or it may have come with damp earth surrounding plants. No one of these suggestions is, in Dr. Blanchard's opinion, improbable.

* Ann. Mus. Civ. Stor. Nat. Genova, xxx. (1892) pp. 107–22 (1 pl.).
† Proc. Roy. Ir. Acad., ii. (1892) pp. 402–10 (9 figs.).
‡ Zool. Anzeig., xv. (1892) pp. 474–6 (2 figs.).
§ Tom. cit., pp. 468–70.
‖ Actes Soc. Sci. Chili, ii. (1892) pp. 177–87 (2 figs.).

Horse-Leech in Man.*—Dr. M. C. Francaviglia describes a case in which *Hirudo sanguisuga* occurred with serious, though not fatal, results as a temporary parasite on the nasal mucous membrane of a contadino who had presumably satisfied his thirst incautiously. Other cases of the parasitism of Hirudinea in man are noted.

β. Nemathelminthes.

Mermis nigrescens.† — Dr. v. Linstow describes this nematode whose larvæ are very common in Orthoptera near town, though not in those of the open high-lying country. The sexual forms hide in the earth, in summer after heavy rains they ascend plants. Development occurs in the uterus, the ripe ova contain fully developed embryos and are laid in the earth. Thence the larvæ enter Orthoptera. The author describes the anatomy and histology of the parasite. Suffice it to say that *Mermis* resembles *Gordius* and *Nectonema* in its ventral (as well as dorsal) nerve-strand, and *Ascaris* in the connection between the nerve-strand and the muscles; that like *Nectonema* it has a narrow, thick-walled, chitinous œsophagus and no anus, that it further resembles *Ascaris* in the position of the female genital aperture, and in the presence of two cirri and papillæ on the tail-end of the male. In the absence of an anus, it agrees not merely with *Nectonema*, but with *Ichthyonema*, *Dracunculus*, *Allantonema*, *Atractonema*, *Aprocta*, and other Filariæ.

Sub-cuticular Layer of Ascarids.‡—M. L. Jammes describes the development by the young *Ascaris* of a cuticular layer which protects it from the action of the digestive juices in the midst of which it lives. He points out that this cuticle exerts a direct influence on the organism which it protects, for it causes an arrest in the development of the primitive cellular ectoderm. In thus early suppressing most of the external relations it makes any division of labour extremely difficult. The anatomical differentiations which distinguish the nervous system from the rest of the ectoderm do not appear.

The largest number of cells is found in the cephalic region and around the canal and seminal orifices; in the intermediate regions the cells degenerate and form fibrils. It is in this retrograde development that we have to seek for the cause of the variations observed in the number and position of the cells of the granular layer. At first they form a continuous stratum, but soon, many of them having no cause to exist because of the presence of the cuticle, diminish in number; they persist chiefly in the parts which correspond to the first rudiment of the nervous system.

The observations of Marion lead to a belief in the existence, in Nematodes, of a uniform nervous substance, distributed around the animal, and the author believes that he has been able to demonstrate the existence of this substance in *Ascaris*.

M. Jammes is of opinion that the nervous system described by authors and the granular layer are formed by one and the same tissue, the basis of which are the neuro-epithelial elements. These last are

* Bull. Soc. Rom. Stud. Zool., i. (1892) pp. 233-41.
† Arch. f. Mikr. Anat., xl. (1892) pp. 498-512 (2 pls.).
‡ Ann. Sci. Nat., xiii. (1892) pp. 321-42 (1 pl.).

provided with a variable number of prolongations, and are unequally distributed in the granular layer; where they accumulate they form the so-called nerve-ganglia. It would seem that we have here another example of the influence of media on living beings.

Anatomy of Myzomimus scutatus.*—Dr. C. W. Stiles gives a detailed account of this Nematode, which is quite common in cattle slaughtered at the Washington (D.C.) abattoir. Even more important than this contribution to the anatomy of Round Worms is the author's conclusion that the individual variation among parasitic Nematodes is very great; a complete series of connecting links can be found between extremes which one would at first be inclined to regard as specifically distinct. Care must, moreover, be exercised in making new species upon mathematical measurement, or upon the presence or absence of one or more pairs of papillæ. Dr. Stiles' observations show that the diagnosis of the family Filariidæ must be broadened, for the form now described, which is an undoubted member of that family, has six pairs of pre-anal papillæ in the male.

Species of Gordius.†—Prof. L. Camerano describes *Gordius aeneus* from Venezuela, *G. Doriæ* sp. n., &c., from Burmah.

Species of Echinorhynchus.‡—Dr. M. C. Francaviglia maintains that *Echinorhynchus globocaudatus* Zeder is really identical with *Ech. tuba* Rudolphi.

γ. Platyhelminthes.

Freshwater Dendrocœla.§—M. G. D. Chichkoff has made a study of *Planaria lactea*, *P. polychroa*, and *P. montana* sp. n. He finds that the cilia are more abundant and more active on the ventral than the dorsal surface. The outer investment of the body consists of a single layer of cells, which are cylindrical in form, and each of which is composed of two parts; the upper is protoplasmic and the lower fibrillar. A delicate cuticle, devoid of pores, has been observed only in *P. montana*. The rods have a double membrane which bounds a cavity which is divided into several small chambers by transverse septa. It is difficult to say exactly what are the functions of these rhabdites, but there is no doubt that they give a certain consistency to the epithelium. The basal membrane consists of a delicate layer of more or less condensed granular protoplasm, and is, in all probability, formed at the expense of the parenchyma.

The number and disposition of the layers which form the tegumentary musculature varies in different types, and even on different surfaces of one species. The outermost layer consists of transverse, and not, as is ordinarily stated, of circular fibres. Dorsoventral and transverse fibres are found in the interior of the body.

The pigment of the parenchyma may be caused to disappear partially or altogether by the continued, and more or less prolonged, action of light. The ducts of the mucous glands never reach the surface; there

* Festschrift . . . Rudolf Leuckart, 1892, pp. 126-34 (1 pl.).

† Ann. Mus. Civ. Stor. Nat. Genova, xxx. (1890-92) pp. 123-7 (1 fig.), 128-31, (2 figs.).

‡ Boll. Soc. Rom. Stud. Zool., i. (1892) pp. 224-32.

§ Arch. Biol., xii. (1892) pp. 435-568 (6 pls.).

is an enormous accumulation of digestive glands, in the form of a belt round the base of the pharynx. The parenchyma proper consists solely of cells with prolongations which intermingle and bound lacunar spaces.

The pharynx is placed in a pouch, and is covered externally and internally by an epithelium which is formed of distinct cells which are provided with pores and are, in places, ciliated. Mucous and salivary glands, the latter of which have not hitherto been detected, are to be distinguished. In the three species examined the intestine has no proper musculature, the place of which is taken by some of the dorso-ventral muscular fibres. The author thinks it very probable that the excretory system communicates with the exterior by canals which pass into the pharynx.

Fertilization is effected in the uterus, which is lined by large glandular cells, the secretion of which aids in forming the cocoon. The brain consists of an upper sensory portion, formed of two ganglia united by a commissure, and an inferior motor of similar constitution. The brain of *P. montana* is intermediate between the simple organ of *P. polychroa* and *P. lactea* and that of *Gunda segmentata* which is differentiated into two distinct parts.

Turbellarian Fauna of Moscow.*—Mr. W. Zykoff has a short note on the Turbellaria found in the neighbourhood of Moscow. He adds seven to the fourteen species already known. *Derostoma unipunctatum* has been found in large numbers; of the many specimens of *D. Cyclops* the majority have the anterior end colourless; the only other place where this species has been found is Prague. A species allied to *Mesostoma personatum*, but distinguished from it by a constriction at the anterior end and by the form of its spots, is referred to, but not named. Only one species, *Polycelis niger*, of Dendrocœla has as yet been found near Moscow.

Pelagic Polyclads.†—Prof. L. Graff gives an account of a few pelagic Polyclads which he has had the opportunity of observing. They are all characterized by the pellucid nature of their body, in which but little pigment is deposited. *Planocera Grubei* and *P. Simrothi* are remarkable for the slight differentiation of the brain, and in the latter species there is a decentralization of the nervous system. *P. Simrothi* affords the second example of the absence of an antero-median branch of the enteron extending over the brain of a Polyclad, and the same species has allowed of the observation that, as Lang has already stated, the ovaries are derived from the enteric epithelium. It also serves very well to show the relations between the form and position of the nucleus and the secretory activity of the cells which form the penial spines. In *P. pellucida* and *P. Simrothi* the oviduct lies in front of the shell-gland, whereas in all other Polyclads the relation of these two structures is reversed. The presence of sperm in the accessory vesicle of the female generative apparatus of *Stylochoplana sargassicola* and *Planctoplana challengeri* calls to mind a similar observation in *Enantia spinifera*, and indicates that the accessory bursa is probably, in most, if not all

* Zool. Anzeig., xv. (1892) pp. 445–7.

† Zeitschr. f. Wiss. Zool., lii. (1892) pp. 189–219 (4 pls.).

Polyclads, a seminal bursa. New forms of accessory female copulatory organs are to be seen in the investment of spines which is found in the bursa copulatrix of *P. challengeri*, and the pharynx-like muscular fold of *Stylochoplana sargassicola*. Observations on *P. Simrothi* show that the uteri are thickenings of the epithelium of the bursa copulatrix.

Some critical observations are made on the nomenclature adopted by Lang in describing the parts of the male copulatory apparatus. The "antrum masculinum" is called the "penial sheath," but the latter name should be reserved for those circular folds which are secondarily formed at the proximal end of the antrum. The name of copulatory organ should be reserved for that part of the male apparatus which serves to convey the sperm. In the simplest case a pyriform muscular bladder with a lumen which gradually widens at its proximal end is, in other cases, separable into a spherical seminal vesicle, a ciliated ejaculatory duct, and a chitinous penis, while the epithelium of the two first divisions, or of one only, or glands which open into it from the exterior, form an accessory granular secretion which is mixed with the sperm. In these cases it is not correct to speak of the copulatory organ as a whole, or the ductus ejaculatorius, or the seminal vesicle as a granular gland, for no special diverticulum has been differentiated.

Parasitic *Distoma* have been observed in *Planocera pellucida*, where they were encapsuled in the parenchyma, and *P. Simrothi*, where they were free in the intestine.

The forms described are *Planocera pellucida*, an account of which was first given by Mertens sixty years ago; it is a holopelagic form which has been found in both the Atlantic and Pacific Oceans; *P. Simrothi* sp. n. was found between the Island of Ascension and the Equator; *P. Grubei* sp. n. has been found in the Atlantic and southern parts of the Indian Ocean; *Stylochoplana sargassicola* is the name given to the *Planaria sargassicola* of Mertens; well-preserved examples of this species were obtained by the 'Hirondelle' in the Sargasso Sea; *Planctoplana challengeri* g. et sp. n. was found off New Guinea by the 'Challenger' in 1875; it has very small tentacles, which indicates that it is a Planocerid, although it has distinct signs of affinity with the Leptoplanidæ. A definite diagnosis is given of the genus.

Systematic Position and Relationships of Temnocephaleæ.*—Prof. W. A. Haswell, who has been continuing his study of *Temnocephala*,† comes to the conclusion that the Trematode affinities of *Temnocephala* preponderate over the Turbellarian; at the same time, it has a number of characters which distinguish it very broadly from any individual Trematode. And, though the large ventral sucker, the excretory sacs, and the nervous system may be set down as decidedly Trematode, and not Rhabdocœl in character, the author would find little reason for finding fault with any one who regarded *Temnocephala* as an aberrant Rhabdocœl, specially modified in accordance with a peculiar mode of life.

Helminthological Notes from Hawaii.‡—Dr. A. Lutz finds that Man, in the Hawaii Islands, may be infested by six parasites, one of

* Abhandl. Naturf. Gesell. Halle, xvii. (1892) pp. 457–60.
† See this Journal, 1892, p. 486.
‡ Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 126–8.

which is *Ankylostoma duodenalis;* the presence of this worm justifies the author's views as to the wide distribution of this parasite in all hot countries; as yet the disease has been found only among the Portuguese residents. In domestic animals *Distomum hepaticum* is very common, and *Echinococci* have been observed. *Echinorhynchus campanulatus* and *Cysticercus Tæniæ crassicollis* have been found in Rats and Mice.

Microcotyle.*—Sigg. C. Parona and A. Perugia have made a monograph of this genus. They give a general account of the structure, a list of the fishes on which various species are parasitic, and a description of eleven species, of which they have discovered four, *M. Salpæ* being now for the first time described.

New Species of Distomum.†—Sig. P. Sonsino describes from *Zamenis viridiflavus* Lacep. two new species of *Distomum*, which he calls *D. subflavum* and *D. Baraldii*. Numerous cysts, perhaps associated with *D. Baraldii*, were also found.

δ. Incertæ Sedis.

Balanoglossus and Tornaria of New England.‡—Mr. T. H. Morgan was led in 1891 to the conclusion that *Balanoglossus Kowalevskii* had a direct development; but he was not certain that the species obtained at Wood's Holl and so named was the same as the similarly named species found at Newport. He has now been able to satisfy himself that the forms are identical. It still remains unknown whether *Balanoglossus* is the parent of the New England larval form which is called *Tornaria*.

Notes on Myzostoma.§—M. H. Prouho, in drawing attention to some points in the structure of *Myzostomum pulvinar* and *M. alatum*, which are parasitic on *Antedon phalangium*, points out that there are three, if not four, types of organization in the Mediterranean species of this genus. *M. cirriferum* is hermaphrodite, *M. alatum* hermaphrodite and protandrous. *M. glabrum* has perhaps a complementary male in addition to being hermaphrodite, while *M. pulvinar* is dicœcious, but the male is a pigmy.

Two new Species of Rotifers.‖—Mr. J. A. Jägerskiöld has a preliminary notice of two new Rotifers which he places in Bergendal's lately described genus *Gastroschiza;* one is called *G. foveolata*, and the other *G. flexilis;* both were found some miles from Stockholm. The latter will, perhaps, have to form the type of a new genus, as its resemblance to *Gastroschiza* may be merely superficial.

Echinoderma.

Yolk-membrane in Echinoderm Ova.¶—Herr C. Herbst has shown that the production of a membrane around unfertilized Echinoderm ova can be brought about not only by chloroform-water, as the Hertwigs showed, but also by clove oil, creosote, xylol, toluol, and benzol. The

* Ann. Mus. Civ. Stor. Nat. Genova, xxx. (1890-92) pp. 173-220 (3 pls.).
† Atti Soc Tosc. Sci. Nat., viii. (1892) pp. 91-5.
‡ Zool. Anzeig, xv. (18 2) pp. 456 and 7.
§ Comptes Rendus, cxv. (1892) pp. 846-9.
‖ Zool Anzeig., xv. (1892) pp. 447-9 (2 figs.).
¶ Biol. Centralbl., xiii. (1893) pp. 14-22.

peripheral layer of the ovum has a firmer consistence than the rest of the egg; an exaggeration of this forms the yolk-membrane: the larvæ are enveloped by an analogous pellicle; around the egg it increases in firmness after formation; the spermatozoon probably stimulates the ovum to a slight chemical change which results in the delimitation and hardening of the plasmic pellicle; so do the reagents noted above. Probably, as Fol suggests, there is formed between the membrane and the ovum some gelatinous substance, which coagulates in the water and raises the membrane. Eggs whose membrane has been shaken off may be stimulated by chloroform, &c., to form another, or a double one may be evoked around fertilized ova. There is no doubt that the conditions producing the membrane are normally within the ovum itself, and it is likely that the spermatozoon supplies the requisite stimulus, analogous to that due to the reagents.

Cuvierian Organs.*—Prof. H. Ludwig and Herr P. Barthels have studied these in ten species of *Holothuria* and in *Mülleria mauritiana* (Quoy and Gaim.). In the last named species and in *Holothuria Köllikeri* Semp., the organs are branched; in the nine other species of *Holothuria* they are simple and cæcum-like. The cæcum-like organ has an axial canal, which Semper denied, and the following layers: an internal epithelium, an internal connective-tissue layer, circular muscles, longitudinal muscles, an external connective-tissue layer, and wandering cells in both layers of connective tissue, and a glandular epithelial layer apparently derivable from the original cœlomic epithelium around the organs. The axial canal of the tubules communicates with the lumen of the respiratory tree; and Hérouard seems to be right in regarding the Cuvierian organs as modifications of branches of the respiratory tree, the structural resemblance being very close. Instead of dividing Cuvierian organs into branched and unbranched, the authors would make the contrast between glandular and non-glandular. The glandular organs are always unbranched, at least no certain exceptions are known: the non-glandular organs are either unbranched (*Molpadia chilensis* J. Müll., *Mülleria maculata* Br.), or branched (*Mülleria lecanora* Jäg., *M. mauritiana* Quoy and Gaim., *Holothuria Köllikeri* Semp.), and have stalked vesicles on their surface (except in *Mülleria maculata*). Their function remains a riddle.

Deposits of Synaptidæ.†—Prof. H. Ludwig remarks that it may seem strange that there is anything new to say about these structures, which have been described so often. He begins with a description of those of *Chiridota pisanii*, traces their development from a minute hexagonal star, and compares them with those of other forms. Synaptidæ with plates may be arranged in two groups—(*a*) those with solid "nave" without a lid (*Myriotrochus*, *Acanthotrochus*, and perhaps *Trochoderma*), and (*b*) those with hollow "nave" and with a lid (*Chiridota* and *Trochodota*). Thus there is a *Myriotrochus* group and a *Chiridota* group. The other Synaptidæ, in which the plates are absent in adult life, may be spoken of as the *Synapta* group, but they are linked to *Chiridota* through *Anapta*.

* Zeitschr. f. Wiss. Zool., liv. (1892) pp. 631–54 (1 pl.).
† Tom. cit., pp. 350–64 (1 pl.).

Deep-sea Asteroidea from the Indian Ocean.*—Dr. A. Alcock gives details of the deep-sea starfishes obtained by H.M. Indian Marine Survey steamer 'Investigator,' of some of which he has already published preliminary notes. The enclosed basin of the Andaman Sea in its moderate depths appears to be peculiarly favourable to starfish life; the calcareous sand and ooze which accumulates between 200 and 300 fathoms seems to afford to Asteroids, as to Ophiuroids and Echinoids, an optimum of development, for there is not only abundance, but also variety. The author has amended the diagnoses of *Persephonaster* and *Dictyaster*, has redescribed five species, and now gives descriptions of three species of *Brisinga*, which before were merely named. In addition to various "new species" there are as new genera *Dipsacaster*, an Astropectinid with no arms, and *Milteliphaster*, which is allied to *Calliaster*, and is most remarkable for the spines on the lower surface, which end in swollen bifid or multifid spines, and recall the long spines of certain Cidaroids.

Organogeny of Amphiura squamata.†—Mr. T. W. MacBride makes a short reply to the recent criticism of M. Cuénot, urging that in one case he has misinterpreted the facts, and in another merely made a guess. As to the small size of *Amphiura squamata* unfitting it for study, it is on this very account favourable, since the preserving fluids penetrate more rapidly and thoroughly than they do in larger forms.

Movements of a Tropical Ophiurid.‡—Dr. C. P. Sluiter describes the swimming movements of a species of *Ophioglypha*, which he observed in his aquarium at Java. It is common at Batavia, where it lives in depths of from 4 to 15 fathoms, and ordinarily creeps about the bottom. When some new animals were put into the tank the small *Ophioglypha* began to make powerful rhythmic movements with its arms. The movement was always so effected that one arm was directed straight backwards and remained immovable, while the other four made powerful backward strokes, then moved slowly forwards, and again made powerful back strokes. It does not appear to matter which arm is used as the rudder. It is clear that this mode of swimming must be quite different from that adopted by *Ophiopteron* where the long arm-spines are connected together by a thin membrane.

Formation of Skeletal Parts in Echinoderms.§—Herr C. Chun has made some observations on the spicules of an Auricularian type of larva which he obtained at the Canary Islands. He finds that, while the skeletal parts of Echinoderms have been regarded as essentially intercellular structures, the forms of the deposits are stretched out within a multinuclear cell by an organic membrane which forms complicated folds, and that in this circumscribed form the hard parts are moulded.

Cœlentera.

East African Coral Reefs.‖—Dr. A. Ortmann describes the coral reefs of Dar-es-Salaam and adjacent regions, which he studied with

* Ann. and Mag. Nat. Hist., xi. (1893) pp. 73–121 (3 pls.).
† Zool. Anzeig., xv. (1892) pp. 449–51.
‡ Tijdschr. Nederl. Dierk. Vereen., iii. (1892) pp. 181–3.
§ Zool. Anzeig., xv. (1892) pp. 470–4.
‖ Zool. Jahrb., vi. (1892) pp. 631–70 (1 pl., 2 figs.).

much personal labour and not without risk. There are neither barrier reefs nor atolls, but shallow-sea fringing reefs, associated with a slow elevation of the coast. Forty-four species of stony corals were found of which 12 were Indo-Pacific, 23 Indian, 5 purely Pacific, and 4 peculiar. Of those described, *Porites reticulum*, *Madrepora* (*Isopora*) *cylindrus*, and *M. horizontalis*, are new species; while a new genus *Astræosmilia*, related to *Dasyphyllia*, is represented by *A. connata*. Ortmann also describes *Millepora tenella* sp. n., and two new Bryozoa, *Tubucellaria gracilior* and *Lepralia dentilabris*.

The Edwardsiæ.*—The results of Mr. O. Carlgren's investigations into these Anthozoa are shown by the following systematic table:—

Tribus Edwardsiæ.

Family Edwardsiidæ. Tentacles developed on the I. *Edwardsia* (8-8) or II. *Edwardsiella*-type (8-12-24)	I. Physa well developed and retractile	*Edwardsia*.
	I. Physa not retractile ..	*Edwardsioides*.
	II.	*Edwardsiella*.
Family Milne-Edwardsiidæ. Tentacles on the Hexactinian type	No acontia or stinging tubercles	*Milne-Edwardsia*.
	Acontia and stinging tubercles	(*Edwardsia*) *Andresi* and *fusca*.

Some account is given of the structure of *Milne-Edwardsia carnea*.

Absorption in Actiniæ.†—M. V. Willem finds, from feeding experiments with carminated food, that the whole of the endoderm of Actiniæ is able to absorb food. The localization of absorbent cells throws into prominence an important point in the arrangement of the different tissues of Actinians, which is correlated with the absence of a true circulatory system. All the regions of the body contain cells in which intracellular digestion takes place and assimilable substances are prepared for the directly adjacent elements. Even the outer wall has an endodermic investment.

The author is of opinion that, although the thin lobes of a typical mesenteric filament are probably ectodermic, the regions of the filaments which separate the lobes from one another and the nutrient zone of the acontia must be considered as endodermic.

Porifera.

Hexaceratina.‡—Prof. R. v. Lendenfeld describes the Adriatic Hexaceratina, i. e. Triaxonia with horny skeleton or none. There are three families, Darwinellidæ, Aplysillidæ, and Halisarcidæ. Of these *Darwinella aurea*, *Aplysilla sulfurea*, *Apl. rosea*, and *Halisarca Dujardini* are described at length. Then the author gives an account of the Hexaceratina in general, which he regards as derived from Hexactinellida.

Morphological Value of the Terms "Osculum" and "Pore" in Sponges.§—Dr. G. C. J. Vosmaer, after a *résumé* of the work of Dendy on the canal system of the Homocœla, discusses the morphological value of the terms "osculum" and "pore"; he points out that these words

* Öfv. Svensk. Akad. Förhandlingar, 1892, pp. 451–61 (6 figs.).
† Zool. Anzeig., xvi. (1892) pp. 10–12.
‡ Zeitschr. f. Wiss. Zool., liv. (1892) pp. 275–315 (1 pl.).
§ Tijdschr. Nederl. Dierk. Vereen., iii. (1892) pp. 235–42.

are used for things which are by no means homologous. The original Olynthus stage was represented by a sac without diverticula; this central cavity, wherever found, should be called the cloaca, and its aperture the osculum. In the wall of the cloaca there is a tendency to form a special skeleton, and the more it developes the more are there definite openings in it, where the diverticula open out; the term procts is applied to the openings of canals or lacunæ into the cloaca. In cup-shaped Sponges the depression corresponds to the cloaca, and the ultimate exhalent apertures of e. g. *Synops* are not oscula but procts.

The ultimate openings may become complicated as in *Cydonium gigas*, when the excurrent chones do not open simply by one proct, but there is a thin covering membrane with a special skeleton and perforated by numerous small openings. These openings Dr. Vosmaer calls proctions. In the same species the inhalent chones exactly resemble the exhalent, and a number of apertures lie together in a membrane (dermal membrane) over one chone; in this membrane there are small orifices which the author proposes to call "stomions," and a group of stomions corresponds to one stoma.

Protozoa.

Infusorian Skin Parasite of Freshwater Fishes.*—Prof. O. Zaccharias describes a species of *Ichthyophthirius* (*I. cryptostomus* sp. n.) which produces small pits in the skin of *Leuciscus rutilus* and of *Alburnus*. The infusorian is oval in form, and measures ·65 – ·8 mm. in length by ·5 mm. in breadth, large enough to be mistaken for a Turbellarian. There is a large horseshoe-shaped nucleus. Cilia cover the surface; the endoplasm contains refractive grains and small crystals and is vacuolar though without contractile vacuoles. No micro-nucleus was detected, nor a distinct mouth, but there is a small pit, which may be a fixing organ, on the ventral surface. As to reproduction, the parasite becomes encysted, divides into two, and by rapid further divisions into 100–150 young forms which have a macro- and a micro-nucleus. Not only does the parasite injure the fish by loosening the epidermis, but it prepares the way for *Saprolegnia ferox* or other fungi. A similar parasite was described in 1876 by D. Floquet under the name *Ichthyophthirius multifillis*.

Flagellata.†—Dr. G. Klebs has made a detailed study of Flagellata, in fact his memoir may be called a provisional monograph. He begins by pointing out that although there are distinct types of Protozoa, there are no rigid boundaries between the different classes. Most Flagellata divide longitudinally, but *Oxyrrhis marina* divides transversely, and it is likely that other exceptions to what seemed not long ago to be a general rule, will be discovered. Klebs enters into a detailed discussion showing that the Volvocineæ must be kept apart from Flagellata; the differences in life-history and reproduction are great. The periplast or external plasmic layer, so characteristic of Flagellates, and the entirely different secondary envelope (*Hülle*), are then described at some length. The following definition is proposed:—

* Biol. Centralbl., xiii. (1893) pp. 23–5.
† Zeitschr. f. Wiss. Zool., lv. (1892) pp. 265–445 (6 pls.).

The Flagellata are simple organisms, which possess a usually well-defined mononuclear protoplasmic body, whose periplast is partly a simple cortical layer and partly a differentiated plasmic membrane. For most of their life they are in active motion or at least capable of such. They have a specially formed anterior end, with a flagellum or several flagella; they have one or more contractile vacuoles. Multiplication occurs by simple longitudinal division, usually in the flagellate state, sometimes when at rest. All are able to form for a shorter or longer time resting cysts. They may be regarded as forming a median group of Protozoa with affinities on all sides, but they have especially close relations with Sarcodina and with Chrysophyta. An exceedingly complete scheme, showing the affinities of Protozoa and Protophyta, is submitted.

Klebs divides the Flagellata into Protomastigina, Polymastigina, Euglenoidina, Chloromonadina, and Chromomonadina, to the description of the types of which 125 pages are devoted.

Flagellate Infusorian as Intra-cellular Parasite.* — Prof. W. A. Haswell noticed a dull yellowish-green colour in an undescribed rhabdocœl Turbellarian found in a pond in Victoria Park, Sydney. This colour was seen to be due to the presence of a large number of active parasites which were found in the interior of unicellular glands or other large cells of the parenchyma. The parasites have much resemblance to *Euglena deses*, the young of which is described as having no flagellum and moving by peristaltic contractions. This appears to be the first observation of any flagellate living as an intracellular parasite, and it may afford ground for those who speculate on the origin of the Sporozoa to adopt, for some of them at any rate, a very different view from that propounded by Prof. Ray Lankester.

Shell of Glenodinium.†—Herr K. M. Levander notes that the investigators of Dinoflagellata have described the shell of *Glenodinium cinctum* Ehrbg. as structureless or without plates. Klebs alone seems to have noticed the plates. These plates Herr Levander now figures and describes. They essentially resemble those of *Peridinium;* there are seven posteriorly and twelve anteriorly. The number and arrangement suggest a union of *G. cinctum* with *Peridinium.*

Gregarines of Holothurians.‡—Mr. E. A. Minchin gives an account of his observations on *Gregarina irregularis* sp. n. from the blood-vessels of *Holothuria nigra*, and *G. holothuriæ* from *H. tubulosa.* In a number of points, such as general structure, possession of two nuclei, general structure of sporozoites and the passing the chief period of their existence in the blood-vessels of Holothurians—the two species agree with one another; as they do, also, in using up all the body-protoplasm to form sporoblasts, in forming eight sporozoites, and in the shape of the spore, which has a funnel at its narrow end. On the other hand, they differ (α) in form; for *G. irregularis* appears to keep its irregular shape up to the time of encystment while *G. holothuriæ* loses it after the young stage; (β) the latter has a caudal process to the spore, which

* Proc. Linn. Soc. N.S.W., vii. (1892) pp. 197–9.
† Zool. Anzeig., xv. (1892) pp. 405–8 (4 figs.).
‡ Quart. Journ. Micr. Sci., xxxiv. (1893) pp. 279–310 (2 pls.).

is entirely wanting in the former; (γ) *G. holothuriæ* is contained in stalked vesicles, which are formed by evagination of the blood-vessel long before encystment, and breaks loose into the body-cavity to sporulate, while *G. irregularis* appears not to evaginate the wall of the blood-vessel until it is ready to encyst, and to sporulate in the vesicle.

Mr. Minchin discusses the attempts that have been made to precisely locate these species, and comes to the conclusion that it is at present best to leave them in the old genus *Monocystis*, and to wait for further researches to determine their true affinities. It is not until the Gregarines of many Holothurians have been thoroughly worked out and compared, that we can be sure what characters are constant peculiarities, and what are merely characters of adaptation. He thinks it is highly probable that the different species of Holothurians will prove to have closely allied species, derived from a common ancestor which inhabited the ancestors of the genus Holothuria.

He justly remarks that the present custom of opening "any animal that comes to hand" and at once describing "the Gregarine that inevitably occurs in it as a new genus and species" is not the way to advance our knowledge of the group.

Life-history of Gregarina.*—Mr. W. S. Marshall has studied *Gregarina* (*Clepsidrina*) *blattarum* v. Sieb. He divides the life-history into three stages:—(1) from the development of the nucleoli, and the origin of the spores (i.e. the bodies within which the spindle-shaped young Gregarines arise) to the formation of the "blastoderm-stage"; (2) the migration of the spores towards the centre, and the formation of eight chromatin bodies; (3) the development of the spindle-shaped young Gregarines. Mr. Marshall has also some observations on the cuticle and the longitudinal fibrils. He believes that what has been repeatedly described as a second nucleus is not really such. A new species of *Didymophyes*—*D. Leuckarti*, from species of *Aphodius*, is described.

Myxosporidia of Gall-bladder of Fishes.†—M. P. Thélohan, who has lately described in the 'Bulletin de la Société Philomathique' for 1892, an interesting species of Myxosporidia, which he calls *Ceratomyxa sphærulosa*, from the gall-bladder of *Galeris canis* and of *Mustelus lævis*, now describes some other new species of the same genus. *C. agilis* has been found in *Trygon vulgaris*; in it the pseudopodia are always placed near the anterior end, in the neighbourhood of which there is constantly a mass of fatty globules. *C. appendiculata* is the name given to the parasite of *Lophius piscatorius*; it contains protoplasmic masses which are remarkable for the existence of long immobile prolongations, formed of an endoplasmic axis which is covered by exoplasm.

In a second communication ‡ M. Thélohan describes *C. arcuata* from the gall-bladder of *Motella tricirrata*; this species is somewhat smaller than the preceding, being not more than 35 or 40 μ in diameter, and the spores are relatively very small. Another form, which, at Roscoff, is very common in *M. tricirrata* and *M. maculata*, becomes the type of a new genus which is to be called *Sphæromyxa* (*S. Balbianii* sp. n.); an incomplete notice is given of its generic characters, but

* Arch. f. Naturg., lix. (1893) pp. 25-44 (1 pl.).

† Comptes Rendus, cxv. (1892) pp. 961-4. ‡ Tom. cit., pp. 1091-4.

attention is directed to the very marked striation of the ectoplasm, as seen in sections; in the form of its spores and the absence of a vacuole from its protoplasm the new type approaches *Myxidium Lieberkühni*, and it ought to be placed in the same family with that genus. A new species of *Myxidium* (*M. incurvulum*) has been found in the gall-bladder of various fishes.

Fresh-water Thuricola.*—Prof. F. Vejdovsky describes *Thuricola Gruberi* sp. n. from a stream in Bohemia; at first sight and with a low power it has a close resemblance to *Vaginicola crystallina;* its nucleus is greatly elongated and very delicate; the organism has two opercula.

Neusina Agassizi.†—Mr. A. Goes describes a peculiar type of arenaceous Foraminifer from the American Tropical Pacific, which he calls *Neusina Agassizi.* Its most striking feature is its stroma, which forms a strong network of very fine chitinous threads, incorporated with a thin layer of finest sand and débris of shells. The test is leaf-shaped, and reminds one of the Alga *Fadina.* Sometimes new individuals bud from the broad side, where they form irregular clusters. The chambers form concentric, more or less complete bands, which increase in length with age. The two ends of the chambers are usually prolonged into a narrow, more or less compressed, hollow appendage with thin walls. The wall of the chamber is thin, and is in places pierced by irregularly formed pores of different sizes. The largest specimens are about 190 mm. in breadth, but, on account of their brittleness, specimens in perfect condition are rarely obtained. This new form was dredged at a depth of 1740 fathoms. Dr. R. Hanitsch ‡ has no doubt that this Foraminifer is one of Haeckel's Deep-Sea Keratosa, and he thinks it is identical with *Stannophyllum zonarium.*

Parasitic Protozoa.§—Dr. M. Braun reports on various recent works on parasitic Protozoa. He calls attention to the appearance of the second edition of L. Pfeiffer's work,‖ which deals especially with the forms which live in the cells and cell-nuclei of other animals. F. Faggioli ¶ has exposed a number of free-living Infusoria to the action of the blood-fluid of various animals, and observed in most cases an extremely deleterious action; this appears to be due to chloride of sodium, for, by the action of a dialyser, blood can be made indifferent. In fact, it would appear that it is to the salt alone that the action is due. Various writers have investigated the *Amœba* of dysentery. There is a considerable amount of literature on the Sporozoa.

Leger ** has published an extensive account of his researches on Gregarines. He divides them into those in which the spores have no shell—Gymnosporidæ (*Porospora* of *Homarus*), and the Angiosporea, in which the spores have a shell; the latter are divisible into two groups; in the first, or Polycystidea, the spores have equal poles; here we have the Clepsidrinidæ, Anthocephalidæ, Acanthosporidæ, Stylorhynchidæ,

* Congrès Internat. Zoologie, II. i. (1892) pp. 52–7 (3 figs.).
† Bull. Mus. Comp. Zool., xxiii. (1892) pp. 195–8 (1 pl.).
‡ Nature, xlvii. (1893) p. 365.
§ Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 61–8, 92–101.
‖ 'Die Protozoen als Krankheitserreger,' Jena, 1891.
¶ "Dell'azione deleteria del sangue sui protisti," Bull. Acad. Med. Genova, vi. (1891) 15 pp. ** Tablettes Zool. (Schneider), iii. (1892) pp. 1–182 (22 pls.).

&c.; in the second, or Monocystidæ, the spores have the poles unequal, and here we have the Gonosporidæ and the Urosporidæ.

Mingazzini has described a number of forms, but the reporter seems to be of opinion that he has instituted too large a number of new genera.

Various notes, some of which have already been noticed in this Journal, have recently been published on Coccidia; Schneider * has given the provisional name of *Nematopsis* to a Coccidium known only in an encapsuled condition in the connective-tissue-cells of *Solen vagina*; P. Willach † comes to the conclusion, for somewhat remarkable reasons, that Coccidia are not Protozoa.

A. Korotneff ‡ has shown that Myxosporidia are to be found in Bryozoa (*Alcyonella fungosa*), where they lead to atrophy of the polypide; as a rule, the infection spreads, and leads to an early death of the whole colony.

It is possible that the *Cercomonas intestinalis*, said by E. Müller § to be present in a man without causing any dangerous symptoms, was not correctly identified. A true *Polimitus* has been found by A. Labbé ‖ in the blood of the Frog. Little has recently been published on the ciliated Infusoria found in Man.

Parasitic Protozoa found in Cancerous Tumours.¶—Dr. M. Armand Ruffer and Mr. J. H. Walker find that with increasing practice they are able to demonstrate parasites in almost every cancer examined; at the same time it is to be noted that section after section may be examined in vain, till "suddenly the observer's patience is rewarded by finding a nest" of them. In fact, the life of the parasites in a cancerous tumour is precarious, and the cell often survives its parasite. In a large majority of cases the parasites of cancer are perfectly spherical; a small nucleus is surrounded by a comparatively large amount of protoplasm; there is a distinct capsule, which is not well marked in tissues hardened with alcohol, but is always plainly visible in carcinomata fixed in Flemming's solution. The nucleus may lie perfectly isolated, but, more frequently, fine delicate rays extend from it to the periphery; the protoplasm may be perfectly homogeneous, or may have a slightly mottled appearance. The capsule appears to be secreted by the invaded cell, and not by the enclosed parasite, from which it is often quite distinct. In most cases an infected cell contains only one parasite, but as many as fifteen have been seen.

The parasites evidently do not always thrive in the cell, and in no case could the authors demonstrate a reproductive process; it appears very probable that the cells secrete a substance which destroys the parasite or, at least, inhibits its growth. As the whole history of the parasites is not yet known, it appears to be useless to attempt at present to classify them.

In a later note ** Dr. Ruffer states that he has seen every stage in the

* Tabl. Zool., ii. (1892) pp. 209-10 (1 pl.).

† Arch. f. Wiss. u. Prakt. Thierheilk., xviii. (1892) pp. 242-62.

‡ "*Myxosporidium bryozoides*," Zeitschr. f. Wiss. Zool., liii. (1892) pp. 591-6 (1 pl.).

§ Verh. Biolog. Ver. Stockholm, ii. (1891) pp. 42-54 (1 pl.).

‖ Comptes Rendus, cxiii. pp. 479-81.

¶ Journ. of Pathol. and Bacteriol., Oct. 1892, 19 pp. (3 pls.).

** Brit. Med. Journal, Nov. 5th, 1892.

life-history of the Protozoa of cancer, from the time when the parasite appears as a spore in the nucleus to the time when it leaves the latter as a young fully-formed parasite, and he expresses the hope that the later stages in the life-history will soon be solved.

Coccidia of Mice.*—Dr. Schuberg has succeeded in breeding spores and sickle-germs by cultivating in water Coccidia cysts obtained from the intestine of mice. The Coccidia cysts are characterized by a relatively thick wall and by contents heaped up together like a ball, which differ from those of *C. oviforme* only in being somewhat smaller and rounder. Occasionally these cysts were found inside an epithelial cell, but more frequently formed small masses on the surface of the mucosa. No further stage of development was observed in the intestine, and it was only by keeping their fæces moist or under water that successful results were obtained. After two or three days under water the contents of the cysts were found to have undergone tetrapartite fission. Each of these four portions became eventually surrounded by a definite membrane, and developed within it two sickle-shaped germs and a residual body. The former are pointed at both ends, and homogeneous in appearance; the latter oval and granular.

The opinion is expressed that *Eimeria falciformis* is probably a stage in the development of this Coccidium, and if so it might be named *C. falciforme*.

* SB. Physik.-Med. Gesell. zu Würzburg, 1892, pp. 65–72.

BOTANY.

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

a. Anatomy.

(1) Cell-structure and Protoplasm.

Structure of Protoplasm.*—By the use of very high powers, Herr E. Crato claims to have established that the protoplasm of a cell always consists of a connected honeycomb-like or reticulate framework; though in certain instances (cilia of swarm-spores, stinging-hairs of *Urtica*) there appear also to be homogeneous threads of protoplasm. All the essential constituents of the cell—the nucleus, chromatophores, and physodes—are to be found in the threads or lamellæ of protoplasm.

In the brown algæ (*Giraudia sphacelarioides*) the protoplasm obviously consists of a moderately regular network of pentagons or hexagons. In the formation of new cells, the cell is first of all divided into two halves, between the two new nuclei, by a septum formed of homogeneous protoplasm. The physodes move towards this septum and supply the materials for the formation of a layer of cellulose within the septum of protoplasm. This is followed by an increase in the vacuoles.

In the higher plants (stinging hairs of *Urtica pilulifera*, growing point of *Elodea canadensis*) the network of protoplasm is composed of finer meshes, and cannot be so clearly made out. The cilia of swarm-spores appear to consist of threads of homogeneous protoplasm; but they also contain typical physodes.

Nature of the Physiological Elements of Protoplasm.†—Herr W. Detmer concludes, from the phenomena presented by protoplasm in the living cell, that each micella consists of a number of living molecules of albumen; and that the atoms of which these molecules are composed are in a state of unstable equilibrium. The structure of living protoplasm may undergo more or less rapid changes:—thus it may pass from a reticulate or honeycomb structure into one which is apparently or actually homogeneous, and then back again to its original condition by a process of rejuvenescence.

It would further appear that there must be specific differences in the physiological properties of the cytoplasm and of the elements of the nucleus in different species, founded on their chemical nature and constitution; and that these differences find an expression in the relationship between the amount of carbon dioxide given off in their normal and in their intramolecular respiration. Designating the former by N, the latter by I, then the proportion $\frac{I}{N}$ would seem to be nearly uniform for different organs of the same species, but to vary greatly in different species. Thus, for the ray-florets of *Calendula officinalis* it is 0·205, for the leaves of the same plant 0·221; for petals of the rose 0·527, for leaves of the rose 0·648.

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 451–8 (1 pl. and 1 fig.).
† Tom. cit., pp. 433–41.

Nucleus and Sexual-cells of Cryptogams.* — Dr. P. Schottländer recapitulates the results obtained by previous observers with regard to the difference in the staining reactions of the elements of the male and female cells in animals and plants, and confirms, in a general way, the statements of Auerbach, Rosen, Guignard, and others. The method followed was that of fixing by Rabl's solution—3 or 4 drops of concentrated formic acid in 100 ccm. of 0·33 per cent. chromic acid. The staining was effected by Rosen's acid-fuchsin methylin-blue method. The chief points of the author's own observations are as follows.

The cytoplasm and all substances contained in it, chromatophores and granules, are stained exclusively red, the enclosed substances taking a deeper tint than the microsomes of the protoplasm, which are arranged in a more or less wide-meshed network. In the sexual cells this is denser, and takes a deeper colour, than in the vegetative cells. The nucleus consists, with a few exceptions, of two substances, one of which is stained blue, the other red. The blue substance forms the reticulate framework, the meshes of which are very narrow; the network consists of very fine slightly stained threads; at the points of junction of these are granules which stain a deeper blue. The ovum-nuclei, which contain no blue substance, have a network with wider meshes, and contain a number of nucleoli, and a nuclear membrane which stains red. In the spermatozoa, which proceed from the nucleus, there are nuclear substances, one red and the other blue, of which the former forms the groundwork, the latter the spiral envelope.

The details are then given of the author's observations in the cases of the following cryptogams,—*Gymnogramme chrysophylla*, *Aneura pinguis*, *Marchantia polymorpha*, and *Chara fœtida*. In the spermatozoa of *Gymnogramme* the apparent transverse striation is the result of a spiral envelope of the blue substance which coils round the substance of the band composed of a red substance. No "germinal spot" could be detected in the ovum-cell in this or other instances; the phenomenon so described being the result of a misinterpretation.

In all vegetative nuclei the nucleole consists of a red substance. No attraction-spheres (tinoleucites) were observed in any vegetative cells. The number of coils of the spermatozoa is 3–4 for *Chara*, $3\frac{1}{2}$ for *Aneura*, $2\frac{1}{2}$ for *Gymnogramme*, and less than 1 for *Marchantia*. In the spermatozoa of *Marchantia* tinoleucites, or at least their centrosomes, were observed in all stages of development; they were also seen in *Gymnogramme* and *Chara*, and are probably an essential constituent of spermatozoa. The ovum-nucleus contains no blue substance, which, on the other hand, forms at all events the greater part of the constituents of the spermatozoa. The author believes that the cytoplasm of the male cells plays a not unimportant part in impregnation; at least the cilia are formed from it.

The difference in the staining reactions of the male and female nuclei is accompanied by a difference in their finer structure; the ovum-nucleus has a nuclear membrane, which is wanting in the spermatozoon; nucleoles are wanting in the male nuclei, while they are large and

* Beitr. z. Biol. d. Pflanzen (Cohn), vi. (1892) pp. 267–302 (2 pls.). Cf. this Journal, 1892, p. 516.

numerous in the female nuclei; there is also a difference in the structure of their framework.

Elementary Structure of the Cell.—Replying to an objection of Pfeffer's, Dr. J. Wiesner * states that, according to his view, the plasomes of one and the same cell resemble one another only in their main features —such as divisibility, growth, assimilation—but that they differ from one another in specific properties.

Cell-division following Fragmentation of the Nucleus.† — Sig. L. Buscalioni describes the phenomena which take place in the portion of the endosperm which lies between the cotyledons in seeds of *Vicia Faba*. Karyokinetic is gradually replaced by direct division, during which the formation of membrane still takes place, so that an ordinary tissue is formed with a nucleus in each cell. New septa continue to be formed, until at length each nucleus is divided into a number of new ones, and a corresponding number of new cells are formed. This is accompanied by a change in the mode of cell-formation, of the nature of encysting. At certain spots in the endosperm, dark nucleated masses of protoplasm make their appearance, of irregular form, and often connected with one another by delicate threads. These are at first naked, but become enclosed in a membrane of cellulose which is at first very delicate, but becomes gradually thicker. The same membrane will sometimes enclose a number of nuclei.

Callose in Phanerogams.‡—M. L. Mangin recapitulates the microchemical tests by which the presence of callose can be detected, viz.:— It is colourless, amorphous, insoluble in water, alcohol, and Schweizer's reagent, even after the action of acids, very soluble in cold caustic potash and soda, soluble in the cold in sulphuric acid, calcium chloride, and concentrated stannic bichloride, insoluble in the cold in the alkaline carbonates and ammonia, which cause it to swell, giving it a gelatinous consistence. It is more abundant in Algæ and Fungi than in Vascular Cryptogams or Phanerogams, though it occurs frequently in these. It is sometimes formed during the development of the tissues, and plays an important part in the dissociation of tissues and the perforation of membranes. Thus in sieve-tubes it forms, during the period of repose, a cushion which obliterates the sieve-pores, and which disappears when growth becomes again active. It also often remains unchanged in permanent organs till the death of the plant, as in epidermal cells, cystoliths, hairs of the Borragineæ, &c. The tissues in which callose is formed are specially described in the cases of the vine, *Myosotis palustris*, and *Geranium molle*.

Cellulose and its Forms. § — Herr W. Hoffmeister discusses the various modes of preparing pure cellulose and cellulose-gums. He considers it probable that even true cellulose (hydrate of dextrose) is not an independent substance, and that the same is true of cellulose-gum.

* Bot. Ztg., l. (1892) pp. 473–6.

† Giorn. R. Accad. Medicina, April 22, 1892. See Bot. Centralbl., li. (1892) p. 332.

‡ Bull. Soc. Bot. France, xxxix. (1892) pp. 260–7. Cf. this Journal, 1890, p. 734.

§ Landwirthsch. Versuchsstat., xxxix. pp. 461–70. See Bot. Centralbl., 1892, Beih., p. 429.

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

Protein-crystals.* — Dr. G. Stock has investigated the mode of formation and the distribution of protein-crystals in a number of flowering plants, especially in the mature leaves of *Achyranthes Verschaffeltii*, the assimilating tissue of *Rivina humilis*, the leaves of *Syringa vulgaris* and other Oleaceæ, and the spongy and palisade-parenchyme of *Veronica Chamædrys*. There are four modes of occurrence of protein-crystals—in the nucleus, in the chromatophores, in the cytoplasm, and in the cell-sap. The method employed was Zimmermann's Method B, the staining reagent being acid-fuchsin. The more important results obtained are as follows:—

In the plants where they occur protein-crystals are constant constituents of the normal nucleus, or of the normal chromatophores, cytoplasm, and cell-sap. In the cases where they have been observed they have from the first a crystalline form, and do not owe their origin to previously existing spherical structures. Those which are contained in the nucleus and in the chromatophores are not products of secretion; they are dissolved and carried away before the death of the organ in which they occur. Light appears to have no considerable influence on their formation or on their persistence when formed. The protein-crystals of the nucleus and chromatophores disappear with a reduction of the amount of nitrogen in the nutrient solution, and are again formed on a fresh supply of nitrogen. In the plants examined the absence of calcium salts in the nutrient solution causes an accumulation of the crystals. In leaves of *Rivina* the formation of protein-crystals outside the nucleus was induced by the long-continued action of a nitrogenous nutrient solution. In a number of species of Oleaceæ these crystals are very numerous in the bud-scales, and must be regarded as reserve-materials for the winter-buds.

Crystallized Vegetable Proteids.†—Mr. T. B. Osborne finds crystallizable proteids in the following seeds:—brazil-nut, hemp, castor-oil plant, flax, squash. The composition of the crystallized globulins is given. These do not all coincide in chemical properties or in percentage composition.

(3) Structure of Tissues.

Length of Vessels and Distribution of Vessels and Tracheids.‡—Herr A. Adler used for this investigation a solution of ferric oxychloride, which is a colloid, and cannot pass through membranes. If this solution is forced into a closed cell, all the iron is retained by the cell-walls, and pure water passes through. The iron can then be precipitated by ammonia. By this method he found vessels in the petiole of *Pteris aquilina*, but only tracheids in three other species of *Pteris*, and in all other ferns. In the primary and secondary xylem of Conifers he found nothing but tracheids. Vessels were detected in all Dicotyledons examined, and in all Monocotyledons except the root of *Monstera Lennea* and the species of Bromeliaceæ examined. The vessels

* Beitr. z. Biol. d. Pflanzen (Cohn), vi. (1892) pp. 213–35 (1 pl.).

† Amer. Chem. Journ., xiv. (1892) pp. 662–89 (3 pls.).

‡ 'Unters. üb. d. Längenausdehnung d. Gefässräume, u.s.w.,' Jena, 1892, 56 pp. See Bot. Centralbl., lii. (1892) p. 128.

do not form a complete system of tubes through the whole plant, but are interrupted here and there by septa which have not been completely absorbed. The greatest length of vessels measured was in *Aristolochia Sipho* 2·26 m., and in *Robinia pseudacacia* 0·69 m.; the shortest in the leaf-stalk of *Areca lutescens* 3·2 cm. The maximum length was attained in branches four years old.

Assimilating Tissue of Mediterranean Plants.*—M. W. Russell finds that in the littoral plants of the Mediterranean region the presence of an assimilating tissue containing chlorophyll in the stem is more common than in plants of temperate climates, thus presenting an approach towards the special characteristic of desert plants. Several types of this structure are described.

Formation of Secondary Vascular Bundles in Dicotyledons.†—Herr K. Schilberszky finds, from experiments on herbaceous dicotyledonous plants (chiefly *Phaseolus vulgaris* and *multiflorus*), that, if the vascular cylinder of the epicotyl or hypocotyl is cut through, a definite portion of the permanent tissue—viz. the groups of cells which lie nearest to the innermost layers of the parenchymatous primary cortex close to the phloem-bundles—may be incited to divide, and may hence become a secondary meristem. This secondary meristem behaves in the same manner as the cambium, its elements becoming transformed more or less rapidly into xylem and phloem. The initial layer of these extra-fascicular vascular bundles is the starch-sheath, which is specially adapted, by its store of reserve-materials, for the development of their procambial tissue.

Sieve-like Pores in Tracheal Xylem-elements.‡—In a large number of woody leguminous plants, and a few belonging to other natural orders, Herr B. Jönnson finds, within the tracheal system, a structure of the membrane resembling to a great extent the perforation of sieve-tubes. These elements he proposes to term sieve-pore vessels and sieve-pore tracheids. The purpose of these pores appears to be to facilitate the processes of transport and metastasis, and the passage of air. It is probable that, as long as cells are in a living condition, all those which form a uniform tissue are in communication with one another by protoplasmic connections.

(4) Structure of Organs.

Principles of Teratology.§—M. D. Clos proposes a classification of teratological phenomena on a natural system, which he bases on a collocation of all the changes which can take place in any one individual organ. In many cases certain anomalies are characteristic of entire families, as well as of genera and species; and the affinity of families and genera is often indicated by the similarity of their anomalies. On the other hand, some nearly related families are distinguished by the differences in their characteristic anomalies. Varieties and species, and even genera, have been constructed out of teratological phenomena. The

* Comptes Rendus, cxv. (1892) pp. 524–5.
† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 424–32 (1 pl. and 1 fig.).
‡ Tom. cit., pp. 494–513 (1 pl.).
§ Mém. Acad. Sci. Toulouse, iii. (1891) pp. 163–208.

phenomena of coalescence and prolification are discussed in especial detail.

Pistillody of the Poppy.*—Herr K. Schilberszky describes a number of instances of the substitution of pistils for stamens in several species of *Papaver*, especially *P. Rhœas* and *orientale*. This phenomenon, on which he bestows the term "carpomany," may take the form of the production either of partially open or of entirely closed pistils. He regards the phenomenon as demonstrating the correctness of the view that the pistil of *Papaver* consists of as many carpels as there are placentæ or stigmatic rays, and also the affinity of the Papaveraceæ with the tribe Cleomeæ of Capparideæ, and with the Cruciferæ.

Seed-wings of Abietineæ, and closing of the Cones of Coniferæ.†—Freiherr K. v. Tubeuf describes the structure and development of the wings of the seeds in the Abietineæ. Their function appears to be not only to assist the carriage of the seeds through the air, but also to promote their transport by snow-water. The author has observed the carrying away of yew-seeds by blackbirds, but not that of the plum-like fruits of *Salisburia* by any bird.

The various modes are also described in which the cones close after the impregnation of the ovules, in order to protect them during their development, and the way in which they again open to allow of the dissemination of the seeds.

Casting-off of the Tips of Branches.‡—Mr. A. F. Foerste describes the mode in which certain American trees—*Catalpa speciosa*, *Staphylea trifolia*, *Ailanthus glandulosa*, *Æsculus Hippocastanum*, *Tilia americana* and *platyphyllos*—throw off the tips of their branches at the end of the period of vegetation. This appears to be a contrivance to secure a determinate growth of the branches, and to obviate the useless expenditure of energy when the branches are killed back by winter frosts, as is always the case with many trees.

Comparison of Cotyledons and Leaves.§—M. E. Pée-Laby has studied the comparative anatomy of cotyledons and foliage leaves in about 300 species belonging to all families of Dicotyledons. The epidermal cells of cotyledons are usually larger than those of the leaves, and have generally more wavy and thinner walls. The stomates of the cotyledons are usually more rounded; stomates may be present even on underground cotyledons at the end of their period of germination. No hypoderm is to be found in cotyledons, and no palisade-parenchyme is ever present on both sides. The veins of cotyledons are generally curved; the vascular bundles consist only of primary xylem with a few vessels, and primary phloem with a few short elements. An endoderm is more common with cotyledons than with leaves.

* Abhandl. Ungar. Akad. Naturw., xxii., 79 pp. and 7 pls. See Bot. Centralbl., lii. (1892) p. 416.

† Hab.-Schrift f. d. technische Hochschule in München, 1892 (3 pls.). See Bot. Centralbl., lii. (1892) p. 366. Cf. this Journal, 1892, p. 505.

‡ Bull. Torrey Bot. Club, xix. (1892) pp. 267–9 (1 pl.).

§ 'Rech. s. l'anat. comp. d. cotylédons et d. feuilles d. Dicotylédonées,' Toulouse, 1892, 144 pp. and 5 pls. See Bot. Centralbl., li. (1892) p. 345. Cf. this Journal, 1892, p. 817.

Tropical Foliage.*—Prof. G. Haberlandt contrasts the characteristics of the foliage in the tropics, as observed at Buitenzorg in Java, with that of temperate climates. The chief peculiarity observed was the much smaller amount of transpiration. The mechanical aids for this diminution of transpiration are a thick-walled strongly cutinized epiderm, depressed stomates, and especially a variety of forms of reservoirs for water, such as an aquiferous tissue, mucilage-cells, and storing tracheids. These perform the double function of preventing the withering of the leaves in the hot sunny forenoon, by which assimilation would be hindered, and of promoting the distribution during the night of the water which is plentifully absorbed through the roots. It is noteworthy that these peculiarities are also those which enable a plant to pass from a terrestrial to an epiphytic mode of existence.

Abnormal Leaves.†—Prof. J. Klein has investigated the phenomena connected with divided leaves, both in the case of those that are normally opposite (*Nerium Oleander*, *Weigelia rosea*, *Lonicera fragrantissima*, *L. tatarica*, *Syringa vulgaris*, *Philadelphus coronarius*, *Calycanthus floridus*, *Vincetoxicum officinale*, *Asclepias pulchra*), and those that are normally spiral (*Morus alba*, *M. nigra*, *Ficus australis*, *Cydonia vulgaris*, *Pyrus amygdaliformis*, *Robinia Pseudacacia*, *Phaseolus vulgaris*). The cause of the phenomenon differs in different cases. In some it is the result of a union of two leaves, and then the number of vascular bundles which enter the lamina is double the ordinary number or more; in others it is the result of division, and then the number of vascular bundles is normal, although there is no external difference between leaves belonging to the two categories. The first of these two malformations is a frequent result of lopping, and is especially common in *Morus* and *Lonicera fragrantissima*.

Petiole of Phanerogams.‡—M. L. Petit points out that, notwithstanding the variations in the course of the vascular bundles in the leaf-stalk, there are only a small number of types, and that these are characteristic of whole families, or of genera. In Monocotyledons and Gymnosperms the bundles are never united into a common ring or arch, but remain distinct. The Marantaceæ are characterized by oblique cells at the end of the leaf-stalk, the Dioscoreaceæ by layers of phloem on each side of the bundle. In the Cycadeæ the configuration of the vessels on a transverse section of the leaf stalk serves as a character for certain genera.

Action of the Humidity of the Soil on the Structure of the Stem and Leaves.§—According to M. A. Oger, if plants of the same species are grown, some in a very dry, others in a very moist soil, other conditions being the same, those which are grown in moist soil will assume all the characters—a large size and branching habit, great length of the upper leaves, lax inflorescence, increase in number of the vascular bundles, &c.—characteristic of plants which grow naturally in moist situations. The experiments were made on *Lapsana communis*, *Sonchus*

* SB. K. Akad. Wiss. Wien, ci. (1892) pp. 785–816.

† Jahrb. f. Wiss. Bot. (Pringsheim), xxiv. (1892) pp. 425–98 (6 pls. and 3 figs.).

‡ Actes Soc. Linn. Bordeaux, xliii., 100 pp. and 4 pls. See Bot. Centralbl., lii. (1892) p. 65.

§ Comptes Rendus, cxv. (1892) pp. 525–7.

asper and *oleraceus*, *Mercurialis annua*, *Chenopodium album*, *Balsamina hortensis*, *Impatiens glandulifera*, and *Scrophularia aquatica*.

Thorns of Randia dumetorum.* — Mr. P. Groom discusses the nature of the remarkable thorns of this plant, belonging to the Rubiaceæ, and decides that they are accessory branches. They may develope into a shoot and bear leaves; they arise and grow like a shoot; and their structure agrees with that of a shoot. Their function appears to be the defence of the young branches.

Root-tubercles of Elæagnus and of the Leguminosæ.† —As the results of a series of experiments made on *Elæagnus angustifolius*, Herren F. Nobbe, E. Schmidt, G. Hiltner, and E. Hotter state that seedlings infected with the microbe which produces the root-tubercles are in all cases more vigorous than those which are not infected. The symbiotic microbe is not, however, *Bacterium radicicola*, but a totally different organism.

In the case of Leguminosæ, when the root-system is normally developed, the formation of the tubercles is not dependent on the age of the plant; but young root-fibres can be infected only so long as they still possess root-hairs.

β. Physiology.

(1) Reproduction and Embryology.

Cross- and Self-pollination.‡—Mr. T. Meehan records the following notes on the mode of pollination of American plants:—*Euphrasia officinalis* presents, as Darwin has stated, an arrangement for ensuring self-pollination, notwithstanding its well-marked proterogyny. *Gaura parviflora* (Onagraceæ), which flowers at night, is absolutely self-pollinated, while *G. biennis* appears to be chiefly pollinated by night-flying moths. *Œnothera biennis* is apparently self-pollinated. In *Rhus copallina* the female flowers exude great abundance of a sweet liquid which attracts insects in large numbers; while the male flowers have very conspicuous golden pollen and no honey-glands; no insects were seen to pass from one to the other. In *Dalibarda repens* the female flowers are cleistogamous and self-pollinated. *Lysimachia atropurpurea* is self-fertile, but probably occasionally self-pollinated. *Campanula rotundifolia* produces seeds when insect-visitors are excluded. In *Trifolium hybridum* the abundant fertility is due to self-pollination. *Lathyrus maritimus* appears to be absolutely self-fertile. In *Raphanus sativus* some plants seem to be arranged for cross-, others for self-pollination.

A series of experiments carried out by Miss M. Reed § fully confirm Darwin's statement that cross-fertilized produce more seed-vessels than self-fertilized plants, and that the capsules are heavier. The experiments were made on Petunias.

Pollination of Yucca.‖—Prof. C. V. Riley gives the results of observations carried on through a long series of years, of the pollina-

* Ann. Bot., vi. (1892) pp. 375–9 (4 figs.).

† Landwirthsch. Versuchsstat., xli. (1892) pp. 137–40. See Bot. Centralbl., lii. (1892) p. 379. Cf. this Journal, 1892, p. 234.

‡ Proc. Acad. Nat. Sci. Philadelphia, 1892, pp. 366–83.

§ Bot. Gazette, xvii. (1892) p. 330.

‖ Ann. Rep. Missouri Bot. Garden, 1892, pp. 99–158 (10 pls.). See Bot. Centralbl, lii. (1892) p. 267.

tion of *Yucca filamentosa* by *Pronuba Yuccasella*, and of other species of *Yucca* by other members of the same genus of moths. Self-pollination is exceedingly difficult, and all the species of *Yucca* belong to that class of plants in which fertilization is dependent on the visits of a single species of insect. The adaptations for this purpose in the structure of both flower and insect are described in detail. The female pierces the ovary, and deposits its eggs between the ovules, after which it removes a quantity of pollen from the anthers, and stuffs it into the stigmatic cavity. In this way ten or twelve eggs are deposited, and a corresponding number of ovules destroyed; but, as the number of ovules in the ovary is very large, this does not appreciably affect the fertility of the plant. *Yucca filamentosa* appears to be absolutely dependent on the visits of *Pronuba Yuccasella* for the production of seeds; it also visits *Y. angustifolia;* while *Y. Whipplei* is pollinated by *P. maculata*, and *Y. aloifolia* by *P. synthetica*.

Pollination in the Juncaceæ.*—Herr F. Buchenau has investigated the mode of pollination in a large number of the Juncaceæ, chiefly belonging to the genera *Juncus* and *Luzula*. Excluding the South American genera *Distichia*, *Patosia*, and *Oxychloe*, which are dicœcious, all Juncaceæ are proterogynous. The greater number of the species are cross-pollinated and anemophilous, but some are self-pollinated, and a few are entomophilous. The flowers of *Juncus homalocaulis* are entirely cleistogamous, and cleistogamy occurs also frequently in a few other species of *Juncus* and of *Luzula*, especially in *J. bufonius*. In this species it is usually the terminal flowers of the inflorescence that are cleistogamous, and these have generally three stamens instead of six. The pollen-tubes germinate while still within the anther-lobes, reach the nearest stigma, and fix this firmly to the anther.

Fertilization of the Fig.†—Prof. C. V. Riley enumerates fourteen insects as associated with the caprification of the wild figs of North America. He recommends the importation for this purpose of *Blastophaga psenes* to the fig-growers of California.

Pollination of Cyclamen persicum.‡—Herr P. Ascherson describes the mode of pollination of *Cyclamen persicum*, which corresponds in essential points with that of *C. europæum*. The odour and the very marked proterandry point to cross-pollination as the ordinary mode. But there are, nevertheless, mechanical contrivances by which self-pollination is ensured, failing the visits of insects. A remarkable peculiarity of this species is that it possesses two odours, one belonging to the corolla, as in *C. europæum* and allied species, the other to the anthers. He further describes the mode in which the curvature of the flower-stalk assists in the pollination of the stigma.

Parasitic Castration of Lychnis and Muscari.§—M. A. Magnin confirms, by fresh observations, his previous statement that the phenomena of the castration of *Lychnis diurna* by *Ustilago antherarum*, and of

* Jahrb. f. Wiss. Bot. (Pringsheim), xxiv. (1892) pp. 363–424 (2 pls. and 1 fig.).
† Bot. Gazette, xvii. (1892) p. 281.
‡ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 226–35, 314–8 (8 figs.).
§ Comptes Rendus, cxv. (1892) pp. 675–8. Cf. this Journal, 1892, p. 387.

Muscari comosum by *U. Vaillantii*, are identical. In both cases the parasite simply brings about the more complete development of male organs already present in a rudimentary condition.

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

Adaptation of Seeds to Germination.*—Mr. W. W. Rowlee describes a number of adaptations in seeds to facilitate germination, especially the wing of the fruit of *Acer dasycarpum*, which holds it upright when falling in grass or rubbish. He found that twice as many seeds grow when planted with the radicle below, as when planted with the radicle above.

Germination of Anemone.†—According to M. E. de Janczewski, in some species of *Anemone* the mature embryo contains no differentiated organs, and may therefore be described as acotyledonous. The germination is then very slow, since the cotyledons and root have to be formed during germination, which cannot take place till the following spring. At that period the cotyledons sometimes burst through the pericarp (subgenus Hepatica), or remain completely enclosed, and are replaced by the first leaf (subgenus Sylvia). The germination of the different species of *Anemone* takes place in the following various ways, viz.:—(1) Germination rapid, cotyledons epigæous, nearly sessile, tigel elongated (subgenera Pulsatilla and Anemonanthea); (2) Germination rapid, cotyledons with long petioles, tigel short, underground (*A. alpina*, *narcissiflora*, &c.); (3) Germination slow, cotyledons sessile, hypogæous, tigel short, underground (subgenus Sylvia); (4) Germination slow, cotyledons stalked, epigæous, tigel elongated (subgenus Hepatica); (5) Germination slow, cauline organs of adventitious origin (*A. apennina*). The seedlings of this species present a remarkable anomaly. There is no primary axis, the first leaf being in immediate continuation with the principal root. The secondary axis is an adventitious organ, springing from a portion of the root which is swollen into a tubercle. The first foliar organ may be considered indifferently as a cotyledon or as the first leaf.

Transplantation on parts of Plants.‡—Dr. H. Vöchting records the results of a number of experiments—chiefly on the beet, for the purpose of determining the question whether the parts of a plant can be made to grow by inserting them in any part of another plant of the same species; and also what is the mutual influence on one another of the structures thus brought into contact.

Where the transplanted and the receiving organ are the same, it was found that the experiments succeeded with any section, longitudinal, tangential, or radial, of root, stem, or leaf; and that, under certain conditions, the same holds good where the two organs are different. He concludes from this that there is no organic principle of differentiation between the various organs. The essential condition is that the trans-

* Bot. Gazette, xvii. (1892) p. 278.

† Rev. Gén. de Bot. (Bonnier), iv. (1892) pp. 243–4, 289–301 (4 pls.). Cf. this Journal, 1892, p. 390.

‡ 'Ueber Transplantation an Pflanzenkörper,' Tübingen, 1892, 162 pp., 11 pls. and 14 figs. See Bot. Ztg., l. (1892) p. 815.

planted portion of tissue must be placed in its normal position. If this is not observed, coalescence of growth may take place, but with various disturbances or distortions, or one part may even exercise a poisonous influence on the other. He further arrived at the result that the formation of cambium is brought about by local causes, and may be induced artificially.

The author enunciates the following law,—that every living cell of the root and stem displays polarity, not only in the longitudinal, but also in the radial direction, and has therefore an organic upper and lower as well as a right and left half; and that similar poles repel, while dissimilar poles attract one another. The root-pole of a cell he terms positive, the stem-pole negative. The seat of this polarity is in the protoplasm.

Influence of External Conditions on the Flowering of Plants.*—Prof. M. Möbius discusses this subject in detail, his conclusions being founded largely on observations of Dr. F. Benecke in Java.

In relation to their flowering, Prof. Möbius classifies plants as (*a*) *monocarpic* or *hapaxanthic*, those which flower only once; (*b*) *polycarpic*, those which flower repeatedly. The former may again be either (1) *annual*, or (2) *ephemeral* (i.e. may bring forth several generations in a year, e. g. *Stellaria media*), or (3) may require more than one year to reach the flowering stage; the last are either *biennial*, or *perennial monocarpic* (i. e. require a number of years to produce flowers, e. g. *Agave americana*.) Perennial polycarpic plants may either bloom year after year, or may produce flowers at regular or irregular intervals of more than one year. To the latter class belong species of *Bambusa* and the sugar-cane; the latter frequently does not blossom for many years in succession, and then, in another year, almost every plant will produce flowers, to the great detriment of its sugar-producing properties. With many conifers there is often an interval of from two to six years between one flowering and another; with *Bambusa* as much as thirty-two years has been observed.

With regard to the conditions which promote flowering, it cannot be said that light is essential to the development of the flower, though it is to the capacity of the plant to produce flowers, as it has a tendency to promote the formation of reproductive rather than of vegetative shoots. *Epilobium angustifolium* will flower only in sunny situations, and the brighter the light the deeper is the colour of the flowers. The ultra-violet rays of light are the most efficient for this purpose. With many plants, an alternation of high and low temperatures, involving a period of rest in the winter, is favourable to flowering. Dryness, both in the air and in the soil, is, as a rule, favourable to the production of flowers. When a plant has an abundant supply of nutriment, this goes to the formation of vegetative rather than of reproductive organs.

Importance of Humus for Plants.†—Dr. W. Höveler has investigated the part played by humus in the nutrition of plants containing chlorophyll. Humus, which is always the result of the decay of animal or vegetable substances, is of very complicated composition, consisting of

* Biol. Centralbl., xii. (1892) pp. 609–24, 673–87.

† Jahrb. f. Wiss. Bot. (Pringsheim), xxiv. (1892) pp. 283–316 (2 pls.).

crenic, apocrenic, ulmic, and humic acids, ulmin, and humin. Of these, the first two are soluble in water, the third and fourth in alkalized water, the last two altogether insoluble. The humus affects not only the chemical, but also the physical properties of the soil, rendering it looser and capable of containing a larger quantity of water. In soil containing humus, plants develope a very much more abundant root-system. The roots are able also to penetrate organic substances, such as leaves, bark, wood, &c., and to obtain nutriment from them. A few chlorophyllaceous plants, e.g. *Melampyrum pratense* and *Pedicularis palustris*, possess on their roots special organs—haustoria—which unite in their growth with the organic substances in the soil, and extract nutriment from them. While they are true parasites, they appear to depend mainly on saprophytism for their nutrition. It is only in soil containing humus that the mycorhiza-fungus can develope.

Of the plants with true roots examined, the following were found to be more or less invested by a symbiotic fungus-mycele :—*Orchis maculata*, *Platanthera bifolia*, and *Epipactis latifolia* (endotrophic with rudimentary root-hairs), *Betula pubescens* (ectotrophic, no root-hairs), *Lysimachia vulgaris* (endotrophic, a few root-hairs), *Monotropa hypopitys* (ectotrophic, no root-hairs), *Ledum palustre* and *Andromeda polifolia* (endotrophic, no root-hairs), *Helichrysum arenarium* (endotrophic, a few root-hairs), *Epilobium palustre* and *angustifolium* and *Geum rivale* (endotrophic, no root-hairs.

Bleeding of Plants.*—Dr. A. Wieler discusses in great detail the phenomena connected with the bleeding of plants, understanding by this term not only a flow of sap as a consequence of injury, but any escape of water from a cell, including therefore the trickling of drops from leaves and from fungi, and the secretion of digestive glands. The author argues, from the results of a great variety of observations, that bleeding is a function of special cells, and is manifested when there is an unequal osmotic pressure on the opposite sides of the protoplast of one of these cells. It cannot take place without oxygen, and may be assisted by imbibition. In most trees the phenomenon exhibits an annual periodicity, though this is not always the case ; and the facts with regard to a diurnal periodicity vary greatly in different plants, and even with the same species under different conditions, especially as regards the age of the individual. The escape of the fluid from the digestive glands of insectivorous plants is dependent on exosmose.

Reserves of Water in Plants.†—M. A. Prunet has investigated this subject in the case of a large number of plants, woody, herbaceous, and climbing, especially in relation to the comparative amount of water in the nodes and internodes. He finds that, as a general rule, the nodes of dicotyledonous plants contain a reserve of water capable of remedying, to a certain extent, sudden ruptures of equilibrium between the direct supply through the foliar bundles and the loss by transpiration ; the structure of the nodal tissues is such that the cauline bundles can generally replace the foliar bundles when the supply

* Beitr. z. Biol. d. Pflanzen (Cohn), vi. (1892) pp. 1–211.

† Bull. Soc. d'Hist. Nat. Toulouse, xxv. (1891) pp. 33–70. Cf. this Journal, 1892, p. 60.

through these latter is insufficient, or even when it is entirely suppressed. The whole of the nodes of a stem or of a branch contain a larger quantity of water than the whole of the internodes. Fruit-stalks contain more water than ordinary leafy branches. In those portions of a branch in which growth has ceased, the maximum tension is in the uppermost node, the minimum in the lowest internode. With regard to the distribution of water in different parts of the same internode, the results differed in different plants.

Interchange of Carbon Dioxide and Oxygen between Plants and the Atmosphere.*—From a fresh series of experiments, made on *Lepidium sativum* and *Holcus lanatus*, M. T. Schlœsing finds that during the first six or eight months of growth, the relation between the volume of carbon dioxide consumed and that of oxygen given off by assimilation is considerably less than unity.

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

Normal Respiration of Plants.†—Herr W. Detmer finds that the optimum temperature for respiration is, for seedlings of *Lupinus* and *Triticum*, and flowers of *Syringa* and *Taraxacum*, about 40° C.; for seedlings of *Vicia* and shoots of *Abies*, 35°, and for potato-tubers, 45°. He has established also that seedlings of *Lupinus* and *Triticum* will exhale carbon dioxide at as low a temperature as −2° C.

Transformation of Proteids.‡—In addition to asparagin, Herr E. Schultze finds another nitrogenous substance, arginin, formed at the expense of the proteids in the cotyledons of etiolated seedlings of the lupin and gourd. Arginin is a strongly basic substance of the composition $C_{16}H_{14}N_4O_2$, which forms crystallizable salts.

Decomposition of Albumen in the absence of Free Oxygen.§—Herr W. Detmer concludes, from experiments made on lupin-seedlings, that the results obtained by Palladin ‖ from seedlings of wheat are not altogether correct. He finds that, even in an atmosphere of pure hydrogen, a true decomposition of protoplasm, or separation of its physiological elements, takes place, and not simply an oxidation into asparagin.

Reduction of Nitrates by Plants.¶—M. E. Laurent recapitulates the results arrived at by his previous researches on this subject. Germinating seeds and tubers, as well as a large number of other vegetable tissues, have the power of reducing nitrates to nitrites, and this reduction is a function of vegetable life acting in a medium destitute of oxygen.

γ. General.

Perfumes of Flowers.**—M. E. Mesnard has investigated the locality of the formation of the perfume in a number of flowers (jasmine,

* Comptes Rendus, cxv. (1892) pp. 881–3, 1017–20.

† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 535–9.

‡ Landwirthsch. Jahrb., xxi. (1892) pp. 105–30. See Bot. Centralbl., 1892, Beih., p. 499.

§ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 442–6.

‖ Cf. this Journal, 1889, p. 783.

¶ 'Notes sur la réduction des nitrates par les plantes,' Bruxelles, 1891. See Bot. Centralbl., 1892, Beih., p. 434. Cf. this Journal, 1891, p. 220.

** Comptes Rendus, cxv. (1892) pp. 892–5.

rose, violet, tuberose, orange). He finds that the essential oil is usually present in the epidermal cells of the upper surface of the petals and sepals, but it may also occur on both surfaces. The oil appears, in all cases, to originate in the chlorophyll, and to be a product of its transformation. The production of the perfume is, to a certain extent, in inverse ratio to that of tannin and of the floral pigments; and it is not fully manifested until the essential oil is sufficiently freed from the intermediate products of transformation. It follows that green flowers are seldom scented; while the Compositæ, which are exceptionally rich in tannin, have commonly a disagreeable odour.

Frank's Text-Book of Botany.*—The first volume of this work—a re-issue of Sachs's 'Lehrbuch' enlarged and adapted to the present state of knowledge—deals exhaustively with the structure of the cell, and the general phenomena of anatomy and physiology. Special attention is paid to those branches in which the author has carried on personal investigation, such as the absorption of free nitrogen by plants and fungus-symbiosis.

B. CRYPTOGAMIA

Cryptogamia Vascularia.

Gleicheniaceæ.†—M. G. Poirault has investigated the anatomical structure of the genera *Gleichenia*, *Platyzoma*, *Mertensia*, and *Stromatopteris*; that of *Platyzoma* differs considerably from the normal. All the species of the subgenus *Eugleichenia*, with one exception, have, in the pericycle of their petiole, punctated or reticulate cells with strongly lignified walls; these cells are connected with a sclerenchymatous tissue which occupies the centre of the petiole. They are usually absent from the stem. In *Mertensia* they are either isolated or are entirely wanting. In the central sclerenchyme is a fusiform deposit of brown non-lignified but very hard cells, surrounded by a layer of cells with lignified framework, the endoderm of authors. In the stem or petiole of certain species of *Gleichenia*, some of the sieve-tubes are clothed on the inside with a lignified deposit. The structure of these sieve-tubes resembles that of other ferns.

Leaves of Annularia.‡—From an examination of fresh material, Herr H. Potonié is able to confirm the accepted view that the leaves of *Annularia stellata* must be regarded as the foliage of a plant belonging to the Calamites or Equisetaceæ. The differences are only slight between the leaves of *Annularia stellata*, of *Equisetites zeæformis*, and of *Calamites varians*.

Muscineæ.

Classification of Mosses.§—Prof. C. R. Barnes publishes an analytical key to the genera and species of Musci (Sphagnaceæ, Andreæaceæ, Archidiaceæ, and Bryaceæ) found in North America.

* 'Lehrbuch d. Botanik nach d. gegenwärtigen Stand d. Wissenschaft. Band I.: Zellenlehre, Anatomie, u. Physiologie,' Leipzig, 1892, 227 figs. See Bot. Centralbl., lii. (1892) p. 250.

† Comptes Rendus, cxv. (1892) pp. 1100-3.

‡ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 561-8 (1 fig.).

§ Trans. Wisconsin Acad. Sci., viii. (1892) pp. 11-81, 163-6.

Fontinalaceæ.*—M. J. Cardot gives a monograph of this order of aquatic nearly always pleurocarpous mosses, which he divides into two groups—Fontinaleæ, with leaves almost invariably destitute of veins, and calyptra conical; and Dichelymeæ, in which the leaves have a single often excurrent vein, and the calyptra is dimidiate. The Fontinaleæ include the genera *Hydropogon* (1 species), *Cryptangium* (1 species), *Fontinalis* (35 species, of which two are new), and *Wardia* (1 species); the Dichelymeæ comprise *Brachelyma* (1 species) and *Dichelyma* (4 species). The species of *Fontinalis* are again divided into six tribes, but the specific characters are of very variable value, and the author distinguishes four ranks of so-called species. The species of the first rank are distinguished by very well-marked characters, which appear to have been evolved during long geological periods, and present no transitional forms. The order is nearly confined to the cold and temperate regions of both continents. The ring is wanting in all the species of Fontinalaceæ; the peristome is rarely either wanting or single; it is usually double, as it is in all the species of *Fontinalis;* both exostome and endostome consist of sixteen teeth.

Simplest Form of Moss.†—Prof. K. Goebel regards *Buxbaumia* as representing the simplest primitive form of moss; the sexual organs being borne directly on the filamentous protoneme. The male plant has no stem, but consists of a branch of the protoneme bearing a single terminal antherid. The antherid differs in form from that of the Bryineæ, and resembles that of *Sphagnum* and many Hepaticæ in being globular, and in being borne on a long stalk; it is invested by a leaf which forms a shell-shaped involucre. The leaf is destitute of chlorophyll, and has at its apex not a two-sided apical cell, but cells arranged in a slightly diverging anticlinal series. The female plant is somewhat more highly developed. On a mass of tissue, which represents a rudimentary stem, is borne an archegone surrounded by several involucres, which resemble that of the male plant, but are peculiar in the marginal cells growing out into protonemal filaments. The structure of the sporogone is rudimentary, recalling that of *Sphagnum* and *Andreæa.* It has no true seta, but merely an absorbing organ which penetrates into the rudimentary stem of the moss-plant, giving off a number of rhizoids which absorb nutriment from the stem. The calyptra is ruptured, not by the elongation of the seta, but by the expansion of the theca of the sporogone.

Algæ.

Tuberous Outgrowths of Florideæ.‡—Tuberous outgrowths on certain species of Florideæ have long been known; some of these have been regarded as abortive cystocarps, while others are due to parasitic algæ. Prof. F. Schmitz describes a kind which are produced by the attacks of parasitic bacteria. They have been observed on *Cystoclonium purpurascens*, *Chondrus crispus*, *Prionitis decipiens*, *P. lanceolata*, *Dumontia filiformis*, *Grateloupia filicina*, *Gigartina Teedii*, &c. The bacteria are never found within the cells, but propagate only between them; these attacks produce a kind of gall or hypertrophy of the tissue.

* Mém. Soc. Sci. Nat. Cherbourg, xxviii. (1892) pp. 1–152.

† Flora, lxxvi. (1892) Erg.-Bd., pp. 92–104 (4 pls.); Ann. Bot., vi. (1892) pp. 355–60 (1 pl.)

‡ Bot. Ztg., l. (1892) pp. 624–30.

New Genera of Algæ.*—In a collection of Algæ, freshwater and marine, from Tangier obtained by M. Schousboe, M. E. Bornet finds the following types of previously unpublished genera:—

Nemoderma (Phæosporeæ). Frons horizontaliter expansa crustacea, duobus stratis contexta; inferiori horizontali plano cellulis in fila ramosa radiantia constituto, superiori verticali filis articulatis subsimplicibus apice clavatis muco laxiori cohibitis; sporangia unilocularia, ex articulo intumescente fili medii formata; plurilocularia (duplicis generis?) siliquiformia, terminalia. While agreeing with the Phæosporeæ in the nature of its pigment, this genus differs from all others of the order in its fructification.

Halichrysis (Rhodymeniaceæ). Frons carnosa, horizontalis, plana, undique expansa, subdichotome ramosa; fructibus papillosis superficialibus sparsis fronde innatis prominentibus, polyspermis.

Flahaultia (Rhodophyllidaceæ). Frons plana, membranaceo-carnosa, rigida, varie divisa, stratis fere tribus contexta, interiore filis elongatis articulatis ramosis anastomosantibus, intermedio cellulis rotundato-oblongis laxe conjunctis superficiem versus minoribus, exteriore cellulis verticalibus cylindricis, submonostromaticis, cuticula firmiore tectis composito. Tetrasporæ strato corticali immersæ, sparsæ, zonatim divisæ. Cystocarpia immersa, prominentia, intra pericarpium proprium nucleum compositum foventia. Placenta e cellulis reticulatim anastomosantibus formata, lacunosa, sæpius irregulariter lobata. Fila sporigena ramosa circum placentam radiatim disposita, fasciculata, invicem libera, sporis ex articulis superioribus formatis.

Fertilization of Œdogonium.†—Dr. H. Klebahn has studied the phenomena connected with the coalescence of the male and female elements in *Œdogonium Boscii*. According to the author's observations, the mode of division of the nucleus bears a closer resemblance to that which takes place in the higher plants than would be inferred from Strasburger's drawings, although no distinct spindle-fibres could be detected.

Differences were observable between the cell-nuclei in the vegetative, female, and male filaments, corresponding to differences in the cells themselves. The nuclei of the vegetative cells—whether the cap-cells or those that lie beneath them—are relatively large (about 9 μ), granular, and are each provided with a distinct nucleole. The female nuclei are large, resembling those of the vegetative cells, but less granular, and are provided with a large nucleole; the male nuclei are smaller, very dense and strongly granular, and are not nucleolated.

As regards the act of impregnation, it appears to consist in a complete coalescence of the substance of the two nuclei; no protoplasm is expelled from the ovum-nucleus; the two nuclei can be clearly distinguished from one another after the entrance of the male nucleus into the oosphere, where it increases in size, but undergoes no other change; the absorption takes place after a very short period. No directing-spheres could be detected; and, from the period of the first formation

* Mém. Soc. Sci. Nat. Cherbourg, xxviii. (1892) pp. 165–376 (3 pls.).

† Jahrb. f. Wiss. Bot. (Pringsheim), xxiv. (1892) pp. 235–67 (1 pl.).

of the oogone till that of complete coalescence no excretion of nuclear substance was observed.

The author finds on this species of *Œdogonium* an undescribed parasitic fungus, to which he gives the name *Lagenidium Syncytiorum*. It prevents the formation of septa in the host, but has apparently no injurious effect on the division of the nuclei or cells.

Anatomy and Physiology of Fucoideæ.*—Herr B. Hansteen has investigated several points in the structure of some species of Fucoideæ, especially *Pelvetia caniculata*, *Sargassum bacciferum*, and *Fucus serratus*.

Pelvetia differs from *Fucus* in the entire absence of a mid-rib to the thallus. In both genera the thallus divides by a regular dichotomy, and grows by a strongly differentiated apical cell. The cells of the assimilating tissue are connected with one another by pores. Trichomic structures occur within the bladders of *Sargassum*.

The substance of which the granules found in the assimilating tissue of the Fucoideæ is composed—termed by Schmitz Phæophyceæ-starch—is, according to the author, a carbohydrate of the percentage composition $C_6H_{10}O_5$, to which he gives the name *fucosan*. It is probably the first product of assimilation, and is closely related to the phæoplasts, but appears to originate outside them in the cytoplasm. The microchemical reactions of fucosan are given in detail; the granules are partially soluble in cold, completely so in warm water, and are beautifully stained by methyl-green. Günther and Tollens's fucose is probably a partially inverted fucosan.

Algæ of German New Guinea.†—Herr F. Heydrich, in a collection of Algæ from Kaiser-Wilhelms-Land, describes the following new species:—*Oscillatoria microscopica*, *Ectocarpus elachistæformis*, *Streblonema minutula*, *Bostrychia* (?) *crassula*. Full descriptions are also given of *Anadyomene Wrightii*, *Valonia Forbesii*, *Dictyosphæria favulosa*, *Sebdenia ceylanica*, and *Halymenia lacerata*. In *Anadyomene Wrightii* a mode of propagation is described by akinetes which develope into new individuals without a period of rest. In *Valonia* the apices of the roots appear, by their septation, to play an important part in the alternation of generations. *Sebdenia ceylanica* (Harv.) Heydr. is a synonym of *Halymenia ceylanica* Harv. and of *Kallymenia exasperata* Zan.

Hairs and Bristles of the Chætophoreæ.‡—M. J. Huber points out the vague manner in which these terms have been used in the description of Algæ. He proposes to limit the term hair (*pilum*) to hair-like appendages, whether unicellular or pluricellular, bristle (*seta*) to local prolongations of a vegetative cell, formed either by a simple excrescence of the cell-wall, or by an invagination of layers of protoplasm. The former are nucleated, the latter not. With regard to the genera which make up the Chætophoreæ, *Chætophora*, *Draparnaldia*, and *Stigeoclonium* are characterized by multicellular hairs which terminate branches of an erect and free thallus. In *Herposteiron* the erect branches are replaced by unicellular hairs; in *Aphanochæte* by invaginated bristles; in *Chætopeltis* by mucous bristles. Among the forms

* Jahrb. f. Wiss. Bot. (Pringsheim), xxiv. (1892) pp. 317–62 (4 pls.).
† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 458–85 (3 pls. and 1 fig.).
‡ Journ. de Bot. (Morot), vi. (1892) pp. 321–41 (11 figs.).

which are essentially endophytic; in *Chætonema* the erect branches are terminated or replaced by unicellular hairs; in *Acrochæte* and *Bolbocoleon* they are terminated or replaced by bristles; in *Endocladia*, *Phæophila*, *Blastophysa*, and *Chætosiphon*, the free branches are replaced by bristles.

Trichophilus Neniæ sp. n.*—Under this name Prof. G. v. Lagerheim describes a new species of this genus of Algæ from Ecuador, which forms dark-green patches on snail-shells. It differs from the only species previously known, *T. Welckeri*, parasitic on the hairs of sloths, by the more regular coalescence of its branches into a pseudo-parenchyme, its much smaller cells, and its larger zoosporanges.

Snow-flora of Ecuador.†—Prof. G. v. Lagerheim has investigated the snow-flora of the mountains of Ecuador, and finds 1 species of moss-protoneme, 2 of Fungi (*vide infra*), and 21 of Algæ.

Of the Algæ, 4 are species of *Chlamydomonas*, of which 3 are new, and are named *C. sanguinea*, *asterosperma*, and *glacialis*; all are coloured with a red hæmatochrome of various shades. *C. sanguinea* produces megazoospores, and is also propagated by immotile vegetative cells, the contents of which divide into 8, 16, or 32; zygosperms were not seen. The two other species also propagate by immotile vegetative cells; the zoospores were not observed, but both produce globular zygosperms.

A new genus and species of Ulotrichaceæ is described, *Raphidonema nivale*, with the following generic character:—Thallus filamentosus, simplex, apicibus setiformibus; fila septata libera (non adnata), muco non involuta; membrana non lamellata; chromatophora singula, parietalia, laminæformia, viridia, pyrenoidibus et granulis amylaceis carentia; multiplicatio bipartitione vegetativa transversali filorum.

Among the remaining Algæ are a new species of *Trochiscia*, *T. nivalis*, 2 Desmidiaceæ, 1 Diatom, a *Nostoc*, apparently *N. microscopicum*, and 3 species of *Bichatia* (*Glæocapsa* Ktz.).

Nematophycus.‡—Mr. C. A. Barber describes a new species of this fossil genus from rocks of the Wenlock age, near Cardiff, which he calls *Nematophycus Storriei*. The structure confirms the view of the algal nature of the organism.

Fungi.

Saprophytic Fungus on Snow.§—Among the snow-flora from the mountains of Ecuador Prof. G. v. Lagerheim finds the first instance of a fungus saprophytic on snow, in the type of a new genus, *Selenotila*, with the following diagnosis:—Fungus unicellularis, hyphis genuinis destitutus, gemmiparus; cellulæ (vel gemmulæ) lunuliformes, continuæ, achroæ, solitariæ vel in coloniam ramosam consociatæ. The single species, *S. nivalis*, consists of a single crescent-shaped cell 2–3 μ broad, and 18–30 μ long. The genus may belong to the Hyphomycetes, or may be allied to the Saccharomycetes.

A *Chytridium* was also observed parasitic on *Chlamydomonas sanguinea*.

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 514–8.
† Tom. cit., pp. 517–34 (1 pl.).
‡ Ann. Bot., vi. (1892) pp. 329–38 (2 pls.). Cf. this Journal, 1890, p. 366.
§ Ber. Deutsch Bot. Gesell., x. (1892) pp. 524–5 and 530–1 (1 pl.).

Development of the Mucedineæ.*—M. L. Matruchot has studied the very difficult problem of the polymorphism of some genera of Mucedineæ.

Of *Helicosporium lumbricoides* he finds in cultivation no less than five forms:—(1) a *Helicomyces*-form with non-cutinized membrane, unstable in certain media; (2) a form allied to *Coniothecium;* (3) one with spherical sclerotes; (4) one with budding mycele; (5) a *Stemphylium*-form. Under special conditions *Helicosporium* can be transformed into *Stemphylium*, and this form maintains itself indefinitely in suitable media.

Cephalothecium roseum presents in certain media a *Pseudo-verticillium* form. *Botryosporium hamatum* is identified with *Pachybasium hamatum* and *Verticillium hamatum.*

Gonatobotrys is nothing but a developmental form of *Œdocephalum;* it may consist either of simple (*G. simplex*) or branched (*G. ramosa*) filaments.

A new species, *Fusarium polymorphum*, has four distinct reproductive organs—mono- or pluricellular conids, aerial chlamydospores, mycelial chlamydospores, and arthrospores, the last previously unknown in this genus.

A new genus, *Costantinella*, is characterized by having spreading sterile dusky filaments which are irregularly branched and septated, and spherical hyaline conids springing singly from sterigmas arranged in a crest on the upper part of the basid.

Cell-nucleus and Spores of Yeast.†—Dr. H. Moeller, from observations made on carefully prepared specimens of yeast, finds that each cell is possessed of one nucleus which presents considerable variations as to size, and also as to position. In the isolated round cells it may be in the centre or up against the wall, while in the resting cells it is more frequently observed towards the poles. Neither nucleolus nor nuclear membrane can be demonstrated in stained specimens, but the substance composing the nucleus is probably a thin viscid fluid exhibiting amœboid movements. The granules or microsomes are not easily demonstrated at the same time as the nucleus. The forms resembling spores are declared not to be spores in that they possess neither nucleus nor membrane, and it is concluded that yeasts do not form spores and are devoid of fructification.

Koji, a Ferment producing 18 per cent. of Alcohol.‡—Herren A. Schrohe, G. Liebscher, and V. Magerstein repeat that Koji§ will produce 18 per cent. of alcohol from mash. The process has been patented in America; and, according to the articles of the patent, Koji, or better still, a mixture of Koji and Moto, are added to the wort or mash to be fermented. Moto is made by mixing 40 per cent. Koji with 60 per cent. of starch paste and an equal volume of water. The mixture is then allowed to ferment for 30 to 40 days at a temperature not exceeding 37°.

* 'Rech. s. l. développement de quelques Mucédinées,' Paris, 111 pp. and 8 pls. See Bull. Soc. Bot. France, xxxix. (1892) Rev. Bibl., p. 141.

† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 537–50 (1 pl.).

‡ Zeitschr. f. Spiritus-Industrie, xiv. (1891) pp. 96 and 103; Oesterr. Landw. Wochenbl., xvii. (1891) p. 220. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 467–8.

§ Cf. this Journal, 1890, p. 755.

Liebscher calls attention to the fact that according to Cohn the Koji fungus does not, as Ahlborg states, belong to the genus *Eurotium*, but is to be regarded as *Aspergillus Oryzæ*, and that the fungus possesses the power of saccharizing starch, without, however, forming a ferment. The author seems to think that the Koji fungus acts simply as a preparative on the malt, fermentation being set up by wild yeasts, which are deposited in the mash from the air.

Moreover, the amount of alcohol in Saké is usually over-estimated. The strongest samples of Saké made in Sydney in 1879 showed from 15 to 11·33 per cent. of alcohol. It is, however, quite possible that 18 per cent. was obtained in Japan, for there the fermentation lasts for five to six weeks.

Magerstein seems to think that if Koji results in economy of malt, its addition to potato-brandy mash may not necessarily have a similar effect.

Saccharomyces Jörgensenii.* — Herr A. Lasché isolated from a "temperance" beer which had become cloudy a small yeast of 2·5–5·5 μ diameter. By cultivation on gypsum blocks, spores were formed between 8° to 28° C. These spores were 1 to 2·5 μ in diameter, 2 or 3, rarely 4, being found in one cell. At the optimum temperature, 25°, the first evidences of growth were noticeable in 24 hours. Wort-gelatin was slowly, and pepton-gelatin only partially liquefied. In old wort-gelatin cultivations many cells formed spores, but these were not highly refractive, contained vacuoles, and thus resembled the spores of cultivated yeasts. They only germinated by budding.

Above 30° this yeast dies very quickly. No scum was formed. *S. Joergensenii*, as this new kind of yeast is called, ferments dextrose and saccharose, but not maltose. In this it resembles *S. Ludwigii*, from which it is distinguished by the form of the cells, the manner of spore-formation and spore-germination, and by the absence of scum.

New Torula and Saccharomyces.† — Herr C. Grönland describes the following new yeast-forms found in the Carlsberg Laboratory :— *Torula Novæ Carlsbergiæ*, in the brewery. The cells, of very unequal length, form a pellicle on the surface of the nutrient fluid, and ferment maltose, grape-sugar, and cane-sugar. *Saccharomyces Ilicis* and *S. Aquifolii* were both found on the berries of the holly ; the former usually forms an under-, the latter an upper-ferment.

Hansen's Criticism of the Oidium and Yeast Forms described by Ludwig and Brefeld.‡—In the mucus flux of oaks Ludwig found an Oidium form and a new species of *Endomyces*, *E. Magnusii*, and he inferred that they were developmentally associated ; and yet at the same time he seemed inclined to hold similar views about a *Saccharomyces* discovered in the same material. About the same date Hansen examined a similar material, and found therein an Oidium form which accurately corresponded to Ludwig's *Endomyces Magnusii*, and was also found to set up alcoholic fermentation in dextrose-yeast water solutions.

* Zeitschr. f. d. ges. Brauwesen, 1892, p. 113. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 558.

† Vidensk. Meddel. Kjöbenhavn, 1892. See Bot. Centralbl., lii. (1892) p. 119.

‡ Bot. Ztg., l. (1892) pp. 312–8. Cf. this Journal, 1887, p. 285 ; and 1889, p. 795.

This Oidium form, however, produced no asci, and Hansen sought in vain for *E. Magnusii*, but he did find the particular *Saccharomyces* observed by Ludwig.

Brefeld, however, was able to discover in material supplied to him by Ludwig *E. Magnusii*, the mycele of which showed both the Oidium form and asci; but as it was unable to set up fermentation it was obviously distinct from the Oidium form discovered by Hansen.

Hansen next obtained some fresh material from Ludwig, and found, as he had done before, only the Oidium form capable of exciting fermentation, but not a trace of *Endomyces Magnusii*. Hence the suspicion that there was some genetic connection between *Saccharomyces Ludwigii*, the Oidium form, and *Endomyces Magnusii* was unconfirmed; and the experiments which were made further showed that Brefeld's hypothesis was untenable, viz. that the *Saccharomyces* was only a conid stage of higher fungi which in cultivation had failed to reach the higher form.

Dr. F. Ludwig* doubts the correctness of Hansen and v. Tavel's separation of *Endomyces* (*Saccharomyces*) *Ludwigii* as a distinct species from *E. Magnusii*. There is no morphological difference between the two, the former being probably merely an earlier stage of development of the latter; and, even if the alleged physiological difference can be sustained—that the former has the power of producing fermentation, while the latter has not, which is doubtful, this is not sufficient for the establishment of specific separation.

Dematophora and Rosellinia.†—Sig. A. N. Berlese is of opinion that the parasitic fungus which causes "pourridié" of the vine is not, as is argued by Viala,‡ the type of a new family, allied to the Tuberaceæ, but is a Pyrenomycete nearly related to *Rosellinia*, if it is not to be included in that genus. Several species of *Rosellinia* have a perithece, with inconspicuous or obsolete ostiole, resembling that of *Dematophora necatrix*.

Aureobasidium, a new Genus of Parasitic Fungi.§— MM. Viala and Boyer find that a disease of the vine which attacks the nearly ripe grapes in wet summers, is due to a hitherto undescribed fungus, which they name *Aureobasidium Vitis*, and which constitutes the type of a new genus of Hypochnaceæ. The mycele is greatly branched and septated; the basid is rounded at its apex and is indistinguishable at its base from the mycele; from its spherical apex spring the small uncoloured sterigmas which bear the spores, usually 6 in number, less often 4 or 2, slightly curved when mature.

Fungus-parasite of the Scotch Fir.‖—Herr F. Schwarz has investigated the cause of a disease which has been very destructive to *Pinus sylvestris* in various parts of Germany, and finds that it is due to the attacks of a discomycetous fungus which is probably *Cenangium*

* Bot. Ztg., l. (1892) pp. 793–4.

† Rév. Pathol. Veg., i. (1892) (3 pls.). See Bull. Soc. Bot. France, xxxix. (1892) Rev. Bibl., p. 171. ‡ Cf. this Journal, 1891, p. 650.

§ Ann. Ecole Nat. d'Agric. Montpellier, vi. (1892) p. 153. See Bull. Soc. Bot. France, xxxix. (1892) Rev. Bibl., p. 129.

‖ Zeitschr. f. Forst- u. Jagdwesen, 1892. See Bot. Centralbl., 1892, Beih., p. 472.

Abietis. It is a true parasite, and not a saprophyte, as previously supposed.

Fungus-diseases of Cultivated Crops.*—Dr. P. Voglino has commenced a series of illustrations of the parasitic fungi which are most injurious to cultivated plants. Each part contains a description of the fungus and of the nature of the injury inflicted, with recommendations as to the best remedy, and is illustrated by a coloured plate. The parts at present published relate to the following:—*Ustilago Maydis*, the smut of Indian corn; *Monilia fructigena*, the mould of fruits; *Ustilago segetum*, the smut of corn; *Exoascus deformans*, causing the bladder on peach and plum-leaves; *Puccinia graminis*, the rust of corn; *Phytophthora infestans*, the potato-blight; *Phyllosticta prunicola*, the rust of peach and plum leaves; and *Colletotrichum Lindemuthianum*, the anthracnose of the bean.

Fungus Diseases of the Orange.†—Mr. L. M. Underwood describes a number of diseases to which the orange crop in Florida is liable, of which the following are caused by fungi: — scab, by a species of *Cladosporium;* leaf-spot by *Colletotrichum adustum;* sooty mould by *Capnodium Citri*, which is saprophytic upon honey-dew; leaf-glaze, by a *Strigula*, probably *S. complanata;* also blight, probably by bacteria.

Brown and Grey Barley.‡—Herr A. Zoebl finds that the grey and brown colour of barley-grains which indicates a diseased condition is due to the presence of fungi, chiefly saprophytic, the most abundant being species of *Sporidesmium*, *Cladosporium*, *Dematium*, and *Helminthosporium*. The mycele of these fungi destroys the tissues, especially in the neighbourhood of the vascular bundles, converting it into a brown amorphous mass.

Æcidiconium, a new Genus of Uredineæ.§—M. P. Vuillemin finds a parasitic fungus on the leaves of *Pinus montana*, which he regards as the type of a new genus, and describes under the name *Æcidiconium Barteti*. The genus comes nearest to *Endophyllum* among the Uredineæ, but is distinguished by the predominance of the conidial apparatus over the forms of spores usually found in the Uredineæ. The teleutospores and æcidiospores are to a large extent sterile, the functions of multiplication and dissemination being usurped by the conids.

New Genera of Fungi.‖—The following additional new genera of Hymenomycetous fungi from Ecuador are described by M. N. Patouillard and Prof. G. von Lagerheim:—*Heterochæte*. Fungi heterobasidiosporei, effusi, membranaceo-floccosi v. coriaceo-gelatinosi, undique setulosi; setulis parenchymaticis sterilibus; basidia globoso-ovoidea, cruciatim partita, apice sterigmata bina v. quaterna gerentia; sporæ continuæ,

* 'I Funghi più dannosi alle piante coltivate,' fasc. 1–8, Casale, 1891–92, 84 pp. and 8 pls.

† Journ. Mycol., vii. (1892) pp. 27–36. See Bot. Centralbl., 1892, Beih., p. 531.

‡ Oesterr. Zeitschr. f. Bierbrauerei u. Malzfabrikation, 1892, Nos. 23 and 25; and Allgem. Brauer- u. Hopfen-Zeit., 1892, No. 106. See Bot. Centralbl., li. (1892) p. 344.

§ Comptes Rendus, cxv. (1892) pp. 966–9.

‖ Bull. Soc. Mycol. France, viii. (1892) pp. 113–40 (2 pls.). See Bot. Centralbl., 1892, Beih., p. 416. Cf. this Journal, *ante*, p. 79.

hyalinæ, rectæ v. curvulæ, germinatione promycelium emittentes, in conidium unicum apice productum.

Helicoglœa. Receptaculum homogeneum totum gelatinosum, indeterminate effusum, superficiale, hymenio levi undique vestitum; basidia longissima, primitus recte cylindracea, dein varie flexuoso-incurvata, transverse septata, et in convexa parte plura sterigmata gerentia; sporæ ovoideæ, hyalinæ, sub germinatione filamentum brevissimum emittentes, in conidium unicum sporisque simillimum apice productum.

The same authors * further describe two species of fungi from Ecuador, which they make types of a new genus, *Sirobasidium*, of heterobasidial Hymenomycetes. The following is its diagnosis:—Fungi gelatinosi, pulvinati, ubique hymenio vestiti. Basidia ex apice hypharum oriunda, globosa v. ovoidea, longitudinaliter quadripartita, in catenulas disposita, quarum articuli inferni juniores; e quacumque parte basidii spora unica continua fusiformis acrogena sessilis exoritur. Germinatio sporæ ignota. The ovoid basids divided longitudinally seem to present an analogy with the Tremellini; but *Sirobasidium* is completely separated from that family by the arrangement of the basids in strings with basipetal development and by the absence of sterigmas, an extremely rare occurrence in the Heterobasidiæ. It must probably be placed in the Auricularieæ.

Under the name *Gloiocephala*, Mr. G. Massee † describes a new genus of fungi with the following diagnosis:—Hymenophore circular, plane, the upper sterile surface bearing numerous large projecting cystids which secrete a considerable quantity of hyaline mucus; hymene covering the entire under surface of the hymenophore, and consisting of closely packed basids, each bearing a single spore at the apex; stem central, composed of a fascicle of transversely septate hyphæ. *Gloiocephala* cannot belong to the Basidiomycetes, because of its monosporous basids; its nearest allies appear to be *Physalacria* and *Pistillina*. *G. epiphylla* grows on decaying leaves in Jamaica.

Carnivorous Fungus.‡—Prof. C. M'Millan calls attention to the property of *Polyporus applanatus* of capturing and digesting insects. Flies assemble in swarms on the under surface of the pileus, where they appear to feed on the soft substance of the hymenophore. No viscid secretion could be detected, but the insects get caught in the clefts of the surface, and then die. Immediately a mycelial growth sets up from the interior of the pores, soon completely enveloping the body of the insect, which then becomes completely absorbed, so that scarcely a trace of it is left. After complete digestion fresh pores are formed.

Protophyta.

a. Schizophyceæ.

Glaucospira, a new Genus of Phycochromaceæ.§—Under the names *Glaucospira agilissima* and *G. tenuior* Prof. G. v. Lagerheim describes two new organisms from Ecuador which resemble *Spirochæte* in every

* Journ. de Bot. (Morot), vi. (1892) pp. 465-9 (2 figs.).
† Grevillea, xxi. (1892) pp. 33-4 (1 fig.).
‡ Bot. Gazette, xvii. (1892) pp. 381-2.
§ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 364-5.

respect, except that they contain a blue-green phycochrome, and which seem to present a connecting link between *Spirochæte* and *Spirulina*. The filaments are of a corkscrew form, and were in very active motion, probably from the possession of terminal cilia at both ends.

Conjugation in Diatomaceæ.*—Mr. T. H. Buffham describes a case of conjugation in *Orthoneis binotata*. The entire gelatinous investment of the diatom is termed by him the *periglœa*, and certain long processes which pass through mammiform protuberances of the periglœa at the extremities of the minor axis *tentaculoids*. In the present species these reach a length of 320 μ. It is only the smallest individuals which manifest conjugation. A frustule which has completed, or almost reached, the stage of self-division, has a bulbous addition to the upper part of its periglœa, into which the double frustule rises. The endochrome then passes out of the lower, which may be considered the male, into the upper or female frustule, The upper frustule then divides, and forms two masses of endochrome, which develope into two sporangial frustules of exactly double the length and width of the parent. One valve of the mother-frustule is closely applied to the upper side of the upper sporangial frustule, and the other valve to the lower side of the lower frustule.

The author also confirms his previous observations on the conjugation of *Rhabdonema arcuatum*.

Index to the Photographs of Möller's Preparations of Diatoms.†—Herr J. D. Möller publishes an index of the species delineated in his photographic plates of diatom-preparations. He maintains that most species of diatom vary greatly, and pass over into one another in various directions in the most confusing manner.

β. Schizomycetes.

Development of Bacteria at Low Temperatures.‡—Prof. J. Forster, in the course of some remarks on the viability of Bacteria at low temperatures, shows that the dictum of Migula, though true as a rule, cannot be accepted as a law. Migula stated that the increase of water-germs only took place when the temperature was some degrees above zero. In the course of the past year the author, in co-operation with Herr S. Bleekrode, has made numerous experiments in order to ascertain if bacteria were capable of development at the temperature of melting ice. For this purpose bacteria of sea-water, fresh water, food-stuffs, road-sweepings, and refuse were cultivated in Koch's gelatin, and then on plates. Instead of an incubator a refrigerator was used. In this the plates were kept for over a week, at a temperature of 0°. After 10–12 days the material was examined by transference to Loeffler's bouillon, gelatin, &c., some samples being refrigerated, some incubated at 37°·5.

The results of these experiments showed that only a few kinds of bacteria were able to grow at 0°: yet there were numerous individuals of the kinds found in our daily surroundings, e. g. in food-stuffs,

* Journ. Quek. Micr. Club, v. (1892) pp. 27–30 (1 pl.).

† 'Verzeichniss d. in d. Lichtdrucktafeln Möllerschen Diatomaceen-Präparate enthaltenen Arten,' Wedel, 1892, x. and 176 pp.

‡ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 431–6.

water, &c., which were capable of free development. It was further found that such bacteria multiply so much that in about 12 days (at zero) the colonies on plate cultivations are innumerable; this is confirmatory of the everyday observation that meat preserved in ice rapidly decomposes when thawed.

A practical outcome of these experiments is that if food-stuffs be refrigerated and the air at the same time be *dry*, they will keep better, since the growth of bacteria is materially inhibited by the absence of water.

Osmotic Experiments on Living Bacteria.*—Herr Wladimiroff considers that it is not *a priori* improbable that a process similar to plasmolysis takes place in the bacterium cell when placed in solutions, but believes that the existence of this process cannot be directly determined by the Microscope on account of the smallness of the object. Observations were therefore made on an easily visible vital process as influenced by salt solutions—the mobility of bacteria. This, the author believes, stops at the very moment when plasmolysis occurs. Pure cultivations of *B. Zopfii*, *Bac. cyanogeneus*, *Bac. typhi abdominalis*, *Bac. subtilis*, *Spirillum rubrum*, and an intestinal bacterium were placed in regularly graduated solutions of the following substances:—KCl, NaCl, NH_4Cl, KNO_3, $NaNO_3$, NH_4NO_3, KBr, NaBr, K_2SO_4, Na_2SO_4. The two solutions, of which in one all trace of movement was extinguished, and in the other a trace was just visible, were sought for, and the mean between the two was considered to be the plasmolytic boundary solution. A great number of substances behaved towards bacteria as might have been anticipated from the laws of osmosis—that is, there was a direct relation between the action of the solutions and their molecular value. Some neutral salts, even in dilute solution, stopped the bacterial movements, and this was considered to be the result of a poisonous action rather than of plasmolysis. In others the motor palsy first took place under much higher degrees of concentration than was expected, and in this case it was assumed that the protoplasm was permeable for the substance in question. Again, one and the same substance may be permeable for one species of bacterium, or another may act plasmolytically, and be poisonous to a third. So also very similar substances may have very different actions on the same bacterium—e. g. all forms are permeable to KCl, and impermeable to NaCl. KNO_3 acts plasmolytically on *Bac. cyanogeneus*, and $NaNO_3$ poisonously.

Violet Bacteria.†—Prof. G. v. Lagerheim noticed on boiled potatoes a zoogloea of a deep violet hue, and of very firm consistence. This was found to be made up of rodlike bacteria connected together by a copious mucus. Experiments to obtain pure cultivations failed. There were numerous other bacteria and fungi on the potatoes, and it liquefied gelatin without forming violet colonies. Only five other species of violet bacteria have been described.

* Zeitschr. f. Phys. Chemie, vii. (1891) pp. 529–43. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 96–7.

† Anal. Universidad central del Ecuador, serie iv. No. 39, 1891. See Bot. Centralbl., 1892, Beih., pp. 165–6.

Pigment-bacteria.* — Herr A. Overbeck describes two coloured microbes, *Micrococcus rhodochrous* from the stomach of a goose, and *M. erythromyxa*, from the conduit-water of Halle. The colouring matter of both appears to be a red lipochrome; both are aerobic.

Photobacterium javanense.†—Herr C. Eijkmann describes a new kind of light bacterium, *Photobacterium javanense*, which at first forms separate luminous points on sea-fish, but in a few hours developes so rapidly that the whole surface is covered, and letters may be read at the distance of a few decimetres. Grown in 3 per cent. sugar solution these bacteria are mobile rodlets, with rounded ends, are from 0·8–1 μ broad, and twice to four times as long. Some are so short that they resemble micrococci, while others are much longer and are made up of two or more rodlets. Spore-formation was not observed. Movements took place in curved lines. The flagella were stained by Loeffler's method. These were found at one end, and much exceeded the rods themselves in length. *Photobacterium javanense* does not liquefy gelatin, and on plates forms circular sharply defined colonies with dark centres and margins. These tend to form secondary colonies which gradually become incorporated with the parent colony. The colour of the light is blue-green to whitish, the spectrum extends from yellow-green to violet, the greatest light strength being between the lines E and the middle of F and G. The light is most intense in from 6–12 hours after the formation of the colony, and in 2–3 days there is considerable diminution in intensity. The optimum temperature is between 28° and 38°, but the organism thrives at 15°. The presence of oxygen exerts considerable influence on the development on a free surface, but growth takes place even in an atmosphere of hydrogen, though here the development of light ceases. The optimum temperature for light development is between 25° and 33°, but its actual limits are − 20° and + 45°. Phosphorescence ceases if the temperature be raised to 50°, but returns on cooling, though five minutes' heating to 60° kills the bacteria completely. When cultivated at 47°·5 the growth proceeds with vigour, but phosphorescence ceases, not to be revived on cooling.

Photobacterium javanense is distinguished from other non-liquefying luminous bacteria, e. g. *P. phosphorescens*, *P. Pflügeri*, *P. pathogenicum*, by its lively movements and by its adaptability to a higher temperature. The latter species give out most light at 10°–15°, *P. javanense* at 20°–33°. In this respect *P. javanense* more resembles *P. indicum*, which is distinguished by its blue-white phosphorescence and by its power of liquefying gelatin.

Pigment of Micrococcus prodigiosus.‡—Mr. A. B. Griffiths has separated the blood-red pigment of this organism grown on potatoes. It can be obtained simply by dissolving in alcohol, and gives the empirical formula $C_{38}H_{56}NO_5$.

Microbicidic Action of Carbon Dioxide.§—MM. C. Noury and C. Michel find that, contrary to the usual opinion, if milk is saturated

* Nova Acta K. Leopold-Carol. Akad. Naturf., lv. (1892) pp. 399–416.

† Tijdschr. v. Nederlandsch-Indië, Deel xxxii. Aflevering 4, Batav. Noordwijk, 1892, pp. 109–15. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 656.

‡ Comptes Rendus, cxv. (1892) pp. 321–2.

§ Tom. cit., pp. 959–60.

with carbonic acid gas, it does not destroy the microbes which cause coagulation, though it hinders their development.

Chemistry and Bacteriology of Fermentation Industries.*—The Cantor Lectures on this subject delivered to the Society of Arts by Prof. P. F. Frankland, contain a quantity of information of use and interest to the microscopist, though much, of course, is not new. We must be content to call attention to them.

Toxic Substances produced by Anthrax.†—M. L. Landi isolated from anthrax cultivations and from the blood of animals dead of anthrax proteid bodies, of which those obtained from anthrax blood were to be located—according to their properties and reactions—in a group lying between albuminoids and alkaloids. These substances crystallize and form chloroplatinates. They possess neither toxic properties nor any vaccinating powers. They appear in apparently smaller quantity even in normal rabbit blood. One of three different bases isolated from anthrax blood produced spasms and coma in mice and killed them quickly. The base appears to belong to the pyridin or chinolin bases, and is not present in the blood of healthy rabbits.

Chemical Products of the Life-processes of Bacillus anthracis.‡—Dr. S. Martin cultivated anthrax bacilli for three weeks in an alkaline serum solution. The cultivations were then passed through a Chamberland's filter and concentrated by evaporation at 37°–40°. By repeatedly treating the filtrate with alcohol, a mixture of proto- and deutero-albumoses was obtained. These albumoses were strongly alkaline, and retained their alkalinity after being dialysed for a week, and after precipitation with sodium chloride and ammonium sulphate.

By means of alcohol acidulated with HCl or H_2SO_4 a yellow amorphous body physiologically very different from the albumoses was obtained. If the alkaline albumoses were treated with strong hydrochloric acid and then dialysed for a week, they were converted into acid albumoses. Besides these, there was isolated from the cultivation fluid an alkaloidal body, soluble in alcohol, and resembling in its reactions the vegetable alkaloids.

When injected under the skin of mice, the albumoses, whether acid or alkaline, produced a local œdema, the violence of which corresponded to the amount injected. Certain disease-phenomena ensued on the injections, but death only occurred if large quantities were employed. The spleen was often swollen. The toxicity of the albumoses is relatively small, for pretty large doses were required to produce local or general symptoms. When exposed to boiling heat the albumoses lose their fatal properties. The cumulative action of the albumoses is very marked, e. g. two non-lethal doses act more quickly and powerfully than one fatal dose, i. e. one equal in amount to the two former put together and administered at once. The alkaloidal body also causes a local swelling of the spleen and severe symptoms. It acts much more rapidly and in

* Journal Soc. of Arts, xl. (1892) pp. 911–7, 921–7, 933–41, 947–56 (30 figs.).

† Le Bulletin Med., 1891, p. 919. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 305.

‡ Rep. Local Govt. Board, App. B, 1889–90, pp. 235–50. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 391–2.

smaller quantities than the albumoses. The author concludes that the albumoses and the alkaloid are the toxic and active metabolic products of the anthrax bacilli, both bodies having the same action if they be injected under the skin of some animal sensitive to anthrax; the alkaloid is, however, by far the most potent.

Morphology of Anthrax Bacilli.*—Dr. F. Lüpke calls attention to the fact that the shortest anthrax bacilli are 1·5–2 μ long, and that in larger moderately stained rods septa can be perceived at intervals which accurately correspond to the isolated short rodlets. This observation, and the fact that anthrax filaments caught in sporulation almost always show clear divisions into small equal segments, each of which contains a spore or its rudiment, renders it probable that these small sections and the independent rodlets represent the actual individuals of the anthrax germs.

Aqueous Humour, Micro-organisms and Immunity.†—Prof. E. Metschnikoff concludes from experiments made with aqueous humour that (1) this fluid is a good cultivating medium, not only for micro-organisms in general, but also for that special microbe to which the animal from which the aqueous humour has been taken is immune. (2) In a few cases the bactericidal property of aqueous humour may be demonstrated, but in no case does this property stand in any relation to the immunity of the animal furnishing this fluid. (3) The micro-organisms cultivated in the aqueous humour of animals rendered artificially immune retain their normal virulence. (4) The so-called toxinicidal property can in no wise be attributed to the aqueous humour of animals rendered artificially immune.

The explanation given to reconcile the fact that, while aqueous humour is not only a suitable medium but also possesses germicidal properties, is that the latter action is chiefly due to sudden change of environment, and that the bactericidal power of the humour *in vitro* is due to the fact that the micro-organisms are distributed all over the test-tube, and hence are immediately acted on by the fluid.

Structure of the Cholera Bacillus.‡—Dr. H. van Heurck records some observations made on the cholera bacillus with a Zeiss apochromatic N.A. 1·60. A preparation was mounted in styrax, the cover being made of flint glass. Under these conditions certain appearances of structure were observable. In the filamentous state the structure appears quite homogeneous, but in separated joints 2–4 globules can be perceived; these are stated to be nuclei, one being located at each pole, and the other two lying between.

Another observation disclosed a small group formed apparently of protoplasm on the point of disappearing, within which were nine distinct nuclei. Of these an illustration is given.

The author does not draw any definite conclusion from his observation, but points out that the protoplasmic contents of the bacterium are not so simple as were supposed.

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 391.
† Journ. of Pathol. and Bacteriol., l. (1892) pp. 13–20.
‡ English Mechanic, lvi. (1892) pp. 164–5 (3 figs.).

Asiatic Cholera in Guinea-pig.*—M. Haffkine has increased and diminished the virulence of the cholera vibrio in the same way as has been done for the bacilli of fowl-cholera, anthrax, &c.

In order to increase the virulence he took from an agar surface a more than fatal quantity of pure cultivation and injected it into the abdominal cavity of an animal, and then, having exposed this overflow fluid for several hours at the ordinary temperature of the air, inoculated other animals therewith. When the poison has in this way passed through several animals it becomes constant, that is, a definite quantity kills the animals in the same time. Animals injected deep in the muscles succumb; after inoculation in the subcutaneous cellular tissue an extensive œdema arises, leading to necrosis of the tissue, though the animal survives.

In order to weaken the poison, the author cultivated the cholera vibrio at 39°, under continual exposure to the air. As subjects soon die under this treatment they must be transferred every 2–3 days to fresh media, and in this way Haffkine succeeded in obtaining cultivations, the subcutaneous inoculation of which was without deleterious consequence.

This was the virus employed as protective against Asiatic cholera. After preliminary inoculation therewith in the subcutaneous cellular tissue, the guinea-pigs bore a similar inoculation with the strong virus without detriment, and an animal doubly inoculated in this way is proof against any inoculation with the cholera virus, and also proof against inoculation through the stomach, when the physiological action of the gastro-intestinal tract has been previously inhibited by opium.

Lasting Abolition of the Chromogenic Function of Bacillus pyocyaneus.†—MM. Charrin and Phisalix have succeeded in depriving *B. pyocyaneus* of its chromogenic function by growing it for several successive generations at 42°·5. The modification thus acquired was transmitted hereditarily, and was retained by descendent cultivations though placed in the most favourable conditions as to temperature and medium.

The cultivations were carried to the sixth generation, and that the colonies were those of decolorized *B. pyocyaneus* was verified by experiments on animals; these suffered from the symptoms produced by *B. pyocyaneus* poisoning, and showed all the lesions found in this disease.

Behaviour of Typhoid Bacilli in the Soil.‡—From experiments Dr. J. Karlinski finds that the typhoid bacillus behaves as follows in the soil:—(1) It may remain alive for more than three months. (2) The duration of life of the bacillus when buried in the soil along with the dejections and left there under ordinary conditions is considerably less than that of bacilli obtained from the blood and buried in the soil in the condition of a pure cultivation; this is probably due to the active competition of other bacteria in the fæces. (3) In the deep layers of the soil, the typhoid bacilli are able to resist changes of temperature

* La Semaine Méd., 1892, No. 36. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 258–9.

† Comptes Rendus, cxiv. (1892) pp. 1565–8.

‡ Archiv f. Hygiene, xiii. p. 302. See Annales de Micrographie, iv. (1892) pp. 353–4.

and humidity as well as the action of the micro-organisms of the soil. (4) On the surface of the soil and exposed to dampness and the sun they perish rapidly. (5) Frequent alternations of humidity, especially when considerable, diminish the duration of life of typhoid bacilli. (6) In those parts of the soil which are penetrated by the roots of plants, the duration of their life is very short. (7) Bodies dead of typhoid fever undergo during putrefaction a considerable elevation of temperature. (8) If putrefaction be retarded and the access of putrefactive organisms be impeded, the bacilli of typhoid may remain alive within the organs of bodies buried in the ground for quite three months.

Existence of Viable Tubercle Bacilli in Prisons.*—Herr Kustermann has made some experiments with the dust obtained by sponging down the walls of rooms in which phthisical prisoners had been kept. The material thus obtained was injected into the abdominal cavity of guinea-pigs with negative results. In the prison in question the precautionary measures against infection had been thoroughly carried out for the past two years, but without any diminution in the cases of phthisis among the prisoners, and the author inclines to the view that there are other circumstances besides the dissemination of particles of dried sputum over the walls and floors of prison rooms, such as mental depression, long confinement in a close atmosphere, and the effects of weather which may conduce to phthisis.

The author's experiments were apparently intended to test the value of Cornet's results, but the conditions of the two sets of experiments were entirely different. Cornet proved that floor dust containing dried phthisical sputum contained viable tubercle bacilli: the author merely shows that no guinea-pig became tubercular after injection with dust from the walls of rooms in which tubercular patients had resided.

Phylacogenous Substance found in Liquid Cultivations of Bacillus Anthracis.†—M. Arloing has found that living cultivations of *Bacillus anthracis* contain soluble vaccinating substances. In the experiments old cultivations, made in large quantities of bouillon, were used. After having stood for a long time the bacteria settle at the bottom of the apparatus, where they form a dense feltwork, the supernatant fluid becoming quite limpid. The clear fluid is then withdrawn by means of a siphon specially adapted for the purpose. The glass legs are plugged with sterilized cotton-wool and connected by a caoutchouc tube. The outside leg, only a little longer than the inner, is drawn out to a narrow point, so that the fluid is siphoned off very slowly and at a minimum pressure. In this way any stray bacteria would probably be caught in the meshes of the cotton-wool filter-plugs. The filtrate is allowed to stand for 24 hours and then siphoned off again. In this way a culture-bouillon was obtained quite free from bacilli but containing their soluble products. By means of intravenous and subcutaneous injections, the latter in series of 10 ccm. each, young sheep were made perfectly immune to anthrax, a result not previously obtained when these animals were inoculated with filtered cultivations.

* München. Med. Wochenschr., 1891, Nos. 44 and 45. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 157–60.

† Comptes Rendus, cxiv. (1892) pp. 1521–3.

Having settled this point, the author made the attempt to ascertain what was the phylacogenous substance, or at any rate the group to which it belonged. Allusion is then made to Hankin's protective albumose, and to the more than negative results which followed when Petermann adopted Hankin's method. The immunizing (phylacogenous) substances were divided into two classes according as they were precipitated by or soluble in alcohol, and with these substances intravenous and subcutaneous injections were made on sheep. Only those animals recovered which had been treated with substances soluble in alcohol; all the others died. From these experiments the author concludes that anthrax bacilli, when cultivated in bouillon, excrete a vaccinating substance, and that this is soluble in alcohol.

Phagocytosis.—Dr. A. Looss replies * to the reply of Prof. Metschnikoff on the great subject of how the tadpole's tail disappears. According to Metschnikoff it is due to phagocytosis, and the phagocytes which digest the contractile substance are formed from the sarcoplasm and muscle nuclei.

It was this definition of the phagocyte which started the controversy; for, according to the author, as generally accepted, and that too from Metschnikoff himself, who formulated the doctrine, the phagocyte was an amœboid connective-tissue cell or a mobile lymph- or blood-corpuscle. It was therefore surprising to discover that the phagocytes had quite a different origin, and to find it laid down that their own inventor had never identified them with leucocytes. It was suggested to the author that his preparations were unsatisfactory and his interpretation of the facts erroneous.

It was only natural to reply, and the author places in parallel columns extracts from the earlier and later writings of Prof. Metschnikoff, showing how the views of the latter have materially altered. For example the following are contrasted:—

"At the beginning of the metamorphosis amœboid cells accumulate in the vicinity of some tail-muscles," † and yet neither in the muscle itself nor in its neighbourhood are ever perceived any agglomerations of leucocytes.‡ It is hardly possible to avoid the conclusion that a phagocyte may mean almost any kind of cell.

Diplococcus Pneumoniæ and Mastoiditis.§—Dr. A. Scheibe was able in sixteen cases of mastoiditis associated with acute otitis media, to demonstrate both microscopically and by cultivation *Diplococcus pneumoniæ* in nine instances, or 56 per cent. The frequency of the pneumonia coccus is all the more striking if a comparison be made with uncomplicated cases of inflammation of the middle ear.

Bacterial Origin of Bilious Fever of the Tropics.‖—Dr. Domingos Freire finds that the bilious fever of hot climates and yellow fever, though having many resemblances, are perfectly distinguishable by their clinical phenomena, and by their bacteriological characters. The infectious agent of the former is a bacillus; of the latter, a micrococcus. The

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 514–6.
† Biol. Centralbl., iii. p. 561. ‡ Annales Pasteur, vi. (1892) p. 17.
§ Zeitschr. f. Ohrenheilk., xxiii. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 677. ‖ Comptes Rendus, cxv. (1892) pp. 366–8.

blood, bile, urine, as well as the viscera of persons sick of bilious fever, were examined bacteriologically, the cultivation medium was agar in combination with pepton and gelatin. Along the inoculation track there appeared in 24 hours a long white streak of colonies surrounded by numerous gas-bubbles. From all the cultivations colonies with similar characters developed.

The bacillus is about 9 μ long and 3 μ broad. It is motionless, but numerous mobile spores are in its company. It is easily stained by fuchsin and by methyl-violet. The bacilli subdivide in the middle, and in the segments terminal spores develope. The bacillus is pathogenic to guinea-pigs.

Bacillus membranaceus amethystinus mobilis.*—Dr. E. Germano describes a bacillus which forms violet colonies on gelatin plates. It is purely aerobic and grows only at ordinary temperatures. Transferred to gelatin it liquefies very slowly, the medium forming thereon a pretty thick membrane of a distinctly violet hue. In bouillon and on agar the characters are similar, but on potato the violet colour is not developed, the colonies being brownish.

Milk was completely coagulated in 3–4 days.

Hanging drop cultivations showed that the bacilli were very mobile, and about the same length as anthrax, though thinner.

From the general characteristics the author names the microbe *B. membranaceus amethystinus mobilis.*

Bacillus methylicus.†—Dr. O. Loew describes a bacillus capable of assimilating formic acid, formaldehyd, and derivatives of methyl-alcohol. It was noticed that 0·5 per cent. formaldehydsulphate of soda became cloudy after exposure to the air for 1–2 weeks, and that the turbidity was due to the presence of flakes of a faint reddish colour. The bacillus, which is a short thick rodlet, is about 1 μ broad and 2–2·25 μ long. It is strongly aerobic and does not apparently form spores. It was also cultivated in 0·5 per cent. soda formate and in sterilized methyl-alcohol solution. The red scum which had grown on the formate of soda solution was employed for further culture-observations on gelatin plates, meat-pepton-gelatin, saccharated (2 per cent.) gelatin, agar, and potato. The gelatin was liquefied and the colonies on plates were sharply defined, round or oval, and yellowish.

The micro-organism is chiefly interesting from its chemical relations, its power of assimilating formic acid recalling the assimilative capacity of *Nitromonas* for carbonic acid.

Diagnosis of Bacillus entericus from Bacterium coli commune.‡—Herr L. Luksch points out that the number of flagella on *Bacterium coli commune* serves to render the diagnosis of this micro-organism from the bacillus of typhoid fever comparatively easy. The former schizomycete possesses from 1 to at most 3 flagella, while the latter has from 8–10; moreover the staining of the flagella of *Bacterium coli commune* is always more difficult than in other bacteria.

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 516-9.
† Tom. cit., pp. 462-5.
‡ Tom. cit., pp. 427-31.

Influenza Bacillus and Otitis media.* — Dr. Scheibe detected in the aural discharge from an influenza patient suffering also from otitis media, *Diplococcus pneumoniæ*, *St. albus*, and a species of bacillus which he identified as Pfeiffer's influenza bacillus. The author's own description, however, throws some doubt on this identity, for Scheibe's bacilli are much bigger than Pfeiffer's. They are usually rounded off at the ends, sometimes sausage-shaped, sometimes showing knot-like thickenings. They hardly ever lie in lengths, but remain separate or form groups. Degeneration forms are quite frequent. The bacilli, moreover, are stained by Gram's method.

Influenza Bacteria.†—Dr. Babes states that the bacteria described by him as occurring in the expectoration of influenza patients (1891–92) are identical with the influenza bacilli of Pfeiffer, and he therefore claims the priority of discovery. He is not, however, convinced that these bacilli are the actual cause of influenza, since so many bacteria are present in that disease. In the cases recorded the bacteria were found in enormous masses in mucus, within leucocytes, on the surface of mucosa, and within lymph-spaces and in deep-lying organs. They were described by the author as motionless extremely fine diplobacteria, or short rods about 0·2 μ thick. They did not stain by Gram's method. Grown on agar they formed powdery colonies, and when rubbed into the nasal mucosa of rabbits set up a kind of sepsis and pneumonia terminating fatally.

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* Münchener Med. Wochenschr., 1892, No. 14. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 677.

† Deutsch. Med. Wochenschr., 1892, No. 6. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 667.

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MICROSCOPY.

a. Instruments, Accessories, &c.*

(1.) Stands.

New Student's Microscope.—Mr. E. M. Nelson made the following remarks when exhibiting one of Messrs. Watson's Edinburgh Student's Microscopes with a tripod foot, having an equilateral base whose side is 6½ in. :—"Without dwelling on the ordinary movements, which have been described before, merely mentioning that they are sprung throughout, I will pass on to what may be called the novelties. The first is in the rotating nose-piece. This I have had considerably lightened by doing away with the loose adapting screw, and making it a part of the fixed nose-piece of the Microscope. It will be seen that it now forms a part of the body, which can only be removed by taking out the three screws which usually fasten the ordinary nose-piece on the body. A rotating nose-piece is not one of those pieces of apparatus you sometimes use and at other times dispense with, therefore there can be no objection to fixing it permanently to the Microscope.

The second novelty is in truth an old friend. It is what on a former occasion I called a semi-mechanical stage; in other words, it is a stage with a mechanical movement only in a vertical direction (fig. 15). This you will find an important movement in an advanced student's Microscope. But before proceeding allow me to again state that whatever appliance you may put to a student's Microscope it must leave the stage perfectly plain. Our Continental neighbours sometimes spoil a stage by screwing pieces of watch-spring to it.

This stage is to all appearances one of my plain horse-shoe stages, fitted with a sliding bar, which can be entirely removed. On closer inspection you will see that the edges of the stage are connected with the mechanical movement underneath the stage (fig. 17).

These edges have 3/4 in. of movement by spiral rackwork, the movement being sprung, and the pinion which is carried through has a head on either side of the stage.

The sliding bar slides on these mechanically moving edges, and, consequently, it can be moved either by the rackwork or by the hand. There is an important point which was omitted in my first drawing of this movement; this I soon rectified by making the ledges bear downwards, instead of upwards; if this were not done, a manipulator who rested his hand against the edge of the stage would bend down the guiding lugs, and so injure the whole movement; but by making the ledges bear downwards no injury can happen by pressure from above (fig. 16).

A semi-mechanical stage will be found a great convenience. Every one who has worked with the Microscope knows what an immense advantage a sliding bar is. It holds your slip and enables you to run

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

along a parallel of latitude, by pushing the slide with your finger. To really appreciate the value of a sliding bar, after having used one for some time, go back to a Microscope without one, say a spring clip stage.

Fig. 15.

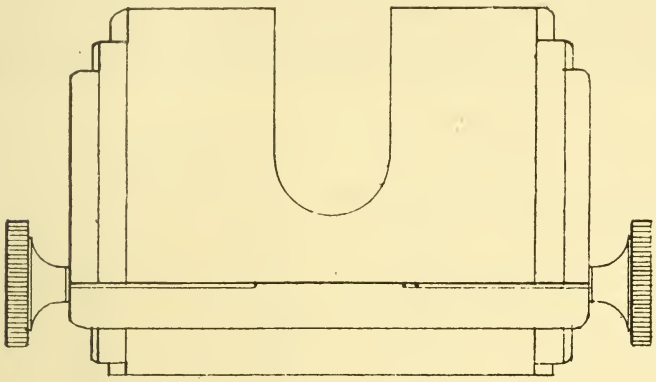


Fig. 16.

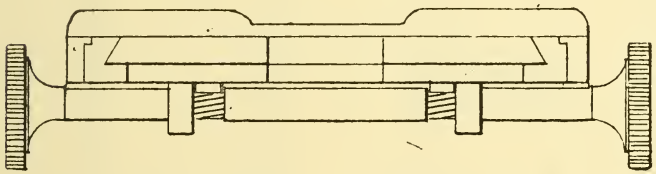
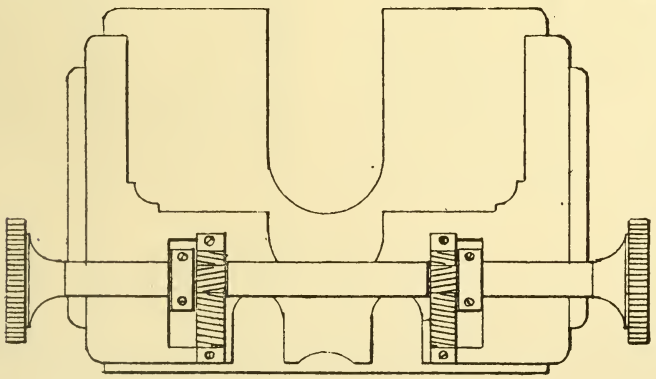


Fig. 17.



This instrument has a stage with a sliding bar, only more so. The main stage is made of 1/4 in. brass plate, and is of ample strength. The whole stage measures $5\frac{1}{4}$ in. wide by 4 in. deep, and the workmanship is excellent, but of that you can judge for yourselves as it is passed round.

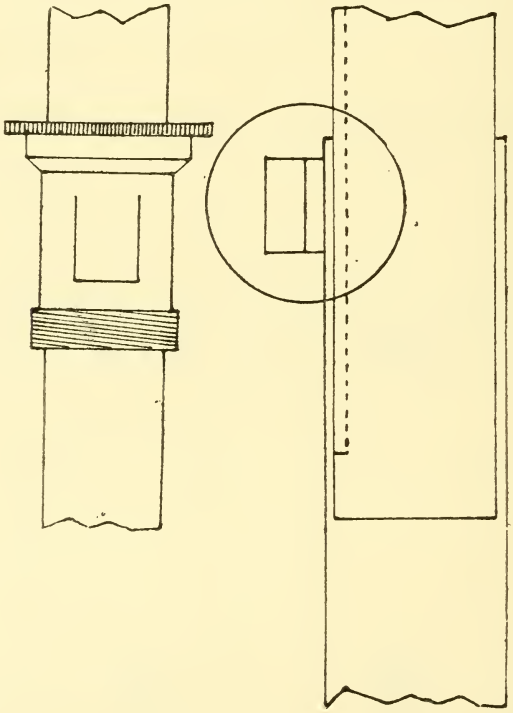
There is one point with regard to the draw-tube, and that is the way

I have had the collar, in which the draw-tube slides, screwed to the main body-tube (fig. 18). The screw is placed below, while a shoulder is placed above, where the screw usually is. This is an important point, because it makes a sound and strong slide, which will not become shaky as is often the case. This kind of fitting is used in the best telescopes.

In connection with this I have an ingenious adaptation of Messrs. Watson to show you for a mechanical draw-tube.

There are two kinds of mechanical draw-tubes at present in use. The first fitted to a Microscope was that by Powell, who cut the inside

Fig. 18. Fig. 19.



tube and placed the rack in the cut (fig. 19). This plan is quite feasible in his Microscope on account of the large size of the tubing; but when we come to small tubing such as this, it is hardly practicable. For this reason No. 2 was invented. It has the inner tube intact, and the outer tube cut, and a box placed over the cut in the outer tube (fig. 20). This is expensive to make. Messrs. Watsons' plan consists in cutting neither tube, but in making the outside tube large enough to take the rack, which projects from the inner tube, and then cutting the collar to allow it to pass (fig. 21). This is the cheapest of the three, and at the same

time quite a sound fitting. In brief the three forms are—1st, the rack let into the inner tube; 2nd, the rack boxed in the outer tube; 3rd, the rack passing through the collar."

Fig. 20.

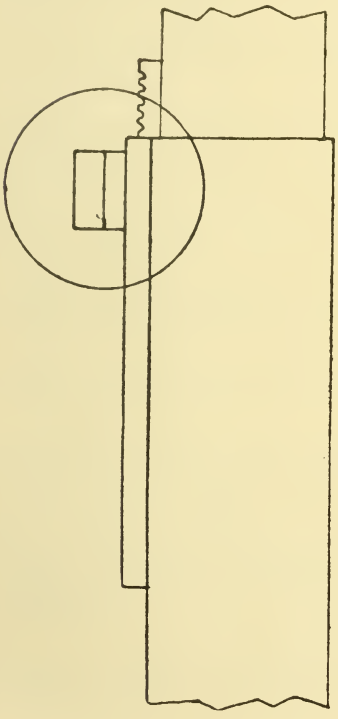
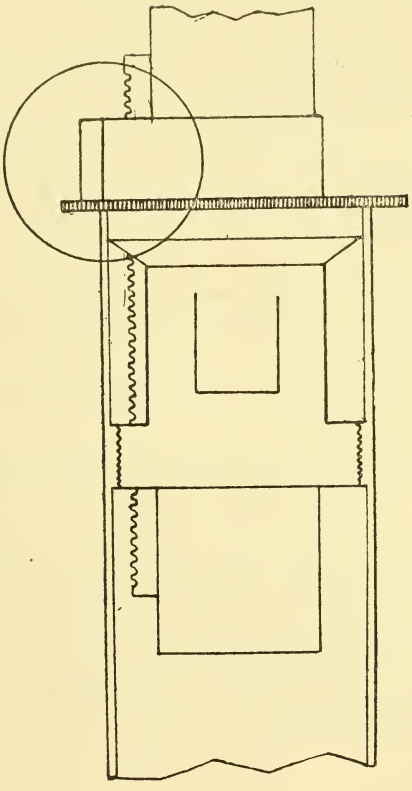


Fig. 21.



(2) Eye-pieces and Objectives.

Use of the Microscope with High-power Objectives.* — M. H. Peragallo points out, without entering into superfluous theoretical considerations, the method of using high-power objectives so as to obtain from them all possible advantages. He first gives a brief *resumé* of the theoretical considerations concerning the formation of images in the Microscope. The classical theory of the formation of images in the Microscope, founded on the emission theory, has long been known to be incapable of furnishing a complete explanation of optic phenomena. Abbe was the first to apply to the formation of images an exact mathe-

* Ann. de Microgr., iv. (1892) pp. 585-616.

matical analysis based on the properties of luminous waves, and from his work there resulted the following principles :—

(1) When the fineness of a structure, i. e. the interval between two elements to be distinguished, is not less than $0 \cdot 10\ \mu$, everything results according to the laws of geometrical optics, and the image is the exact representation of the object. If, after having focused in central light, the eye-piece be removed, a white circle representing the luminous pencil emerging from the objective will be seen on looking into the tube of the Microscope. The diameter of this circle varies according to the focus and aperture of the objective, and also to the aperture of the illuminating pencil.

(2) If the structure is finer, it produces on the illuminating pencil phenomena of diffraction, and on looking into the tube, beside the white dioptric pencil a certain number of coloured diffraction pencils will be seen, of which the number and the arrangement depend upon the nature of the structure examined. These spectra are so much more widely separated as the structure which produces them is finer. Thus, in the case of *Pleurosigma angulatum*, with a high-power immersion objective a central white pencil will be seen with six coloured ones arranged regularly round it, and if the latter are blocked out all traces of structure disappear from the image. Consequently:

(3) The diffraction pencils united in the image, alone give the image of the structure, and:

(4) To a given structure corresponds a certain number of diffraction pencils, and reciprocally to a given number of these pencils corresponds the image of a given structure. But the reciprocity is not absolute, for:

(5) The admission in the image of all the spectra given by a structure is not absolutely necessary for the formation of an exact image of the structure; but it is possible by the non-admission of a certain number of these spectra to either change nothing in the result or to modify it altogether, i. e. in other words to give either the image of the structure or a different image.

Thus consider a series of parallel lines at distances apart ϵ. Beside the pencil of refraction there will be a double series of spectra to the right and left.

(1) S'_4 S'_3 S'_2 S'_1 O S_1 S_2 S_3 S_4 . . .

A structure twice as fine will produce spectra twice as wide apart.

(2) S'_4 S'_2 O S_2 S_4 . . .

In all symmetrical structures the admission of one series alone, right or left, reproduces the image of the structure. In the case of (1), the admission of one only of the uneven spectra reproduces the image; but if by a suitable diaphragm all the uneven spectra are eliminated, and only the even or only one of these retained, then an image corresponding to structure (2) will be produced. Consequently, by eliminating part of the light which reproduces the image of a structure, the image of a structure twice as fine and which does not really exist is obtained.

Accordingly, although the admission of all the spectra is not abso-

lutely essential to the production of a correct image, the only way to ensure such an image is to collect all the spectra produced. But as the structures examined are generally unknown, and since we know *a priori* neither the number nor the arrangement of the spectra produced, we can never know if we collect them all, and consequently we can never know if the image which we observe represents exactly the structure, or even if we do not see the image of a structure which does not actually exist.

From this follows the theoretical conclusion that we can draw from the examination of a microscopical image no mathematically correct deduction as to the real structure of the object which has produced it, if the dimensions of the details of the structure are less than $0{\cdot}10\ \mu$. As an example we have in the case of *Pleurosigma angulatum* six spectra, and only six, whatever may be the obliquity of the illumination. But it is known that a grating composed of two series of lines cutting at 60° gives in the Microscope, beside the central pencil, two concentric series of spectra, the first of six, the second of twelve. By varying the number and arrangement of the spectra admitted, different images can be obtained, but by eliminating the second series altogether an arrangement of spectra similar to that of *Pleurosigma angulatum* is obtained, and an image is produced similar to the structure of that diatom, which, however, does not correspond to the real structure of the grating. Since, then, in the case of *Pleurosigma angulatum* we do not know whether there may not exist a second series of spectra sufficiently separated to escape our present objectives, we cannot affirm that the structure of this diatom is really that of which we observe the image. From these facts two conclusions can be drawn:

(6) It is important to collect the greatest number of diffraction pencils, and as these pencils diverge from the point where they are produced, it is necessary to employ objectives of the greatest possible aperture.

(7) The power of an objective is a direct function of its aperture.

The brightness of the image depends upon two factors,—the aperture of the illuminating pencil and the magnification. Calling ω the aperture of the objective and f the focal length, the brightness of the image will be proportional to

$$f^2\ \omega^2$$

so that in order to obtain the same degree of brightness, as f diminishes ω must be increased.

The maximum aperture which can be practically attained corresponds to an angle in air of 135°–140°.

This angular aperture can be easily applied to an immersion homogeneous objective of 1/8 in. focus, and gives a numerical aperture of about $1{\cdot}40$; but the maximum will be reached if the magnification be pushed much farther, and, instead of augmenting it will be necessary to reduce the aperture. Thus in the catalogues of opticians, e. g. Powell & Lealand, we find the aperture $1{\cdot}50$ applied to objectives of 1/6, 1/8, 1/12, and 1/20 focal length; but to 1/25 only $1{\cdot}38$ aperture and to 1/50 only $1{\cdot}33$ can be given. Beyond a certain limit, then, there is no advantage in augmenting the magnification of the objective. The author

considers that a focal length of 1/12 for the English tube, and 1/18 for the short tube ought not to be exceeded. With these combined with strong eye-pieces, magnifications of 3000 times can be attained. As good examples of such objectives, he cites the No. 9 of Nachet, No. 10 of Verick, the 1/12 and 1/16 homogeneous immersion of Zeiss, and the 1/12 1·30 homogeneous of Leitz.

The power of an objective, then, depends only upon its aperture, which is measured by the product

$$n \sin u,$$

where n is the index of refraction and $2\ u$ the angle under which the extreme rays from the object penetrate into the objective. The power of the objective is represented by the square of its numerical aperture. In a good objective it ought to be possible to utilize 1/3 of the total aperture. This condition is fulfilled when the central luminous circle seen on looking into the body-tube, has a diameter equal to 1/3 of the total diameter of the aperture. Now the ordinary mirror applied to Microscopes throws upon the object a luminous cone of about 30° angular aperture, which corresponds to a numerical aperture of 0·25. With such a mirror therefore an objective having an aperture three times as great, viz. 0·75, can be used. Beyond this, it is necessary to have recourse to special condensing apparatus, furnishing wider illuminating cones.

Taking into account the nature of the light employed, the more correct expression for the power of an objective is

$$p = \frac{n \sin u}{\lambda},$$

where λ is the wave-length.

Thus p can be augmented by diminishing λ, as well as by increasing n and u. The power of an objective expressed as 1 in white light will be 1·08 in blue and 1·32 for the extra-violet rays. It is not surprising therefore that photographs may be obtained of details with objectives which do not resolve them to the eye.

The author gives the following practical directions for the use of high-power objectives:—

(1) To always give to the body-tube of the Microscope the length for which the objectives are corrected, 0·160 m. for the short tube, and 0·250 m. for the English tube.

(2) To employ dry and immersion objectives which are mounted for correction, starting with a numerical aperture 0·75 (about 100° in air). If the graduation of the correction is not given in thickness of cover-glass, to find out the relation between them from the maker.

(3) With homogeneous objectives, whenever it is required to utilize marginal pencils, to optically unite the upper lens of the condenser to the preparation by means of a liquid with index of refraction at least equal to that of the immersion medium, and to only use preparations mounted in a medium of this index.

(4) With these objectives to always use a condenser.

The subject of the illumination of the Microscope receives very complete treatment at the hands of the author.

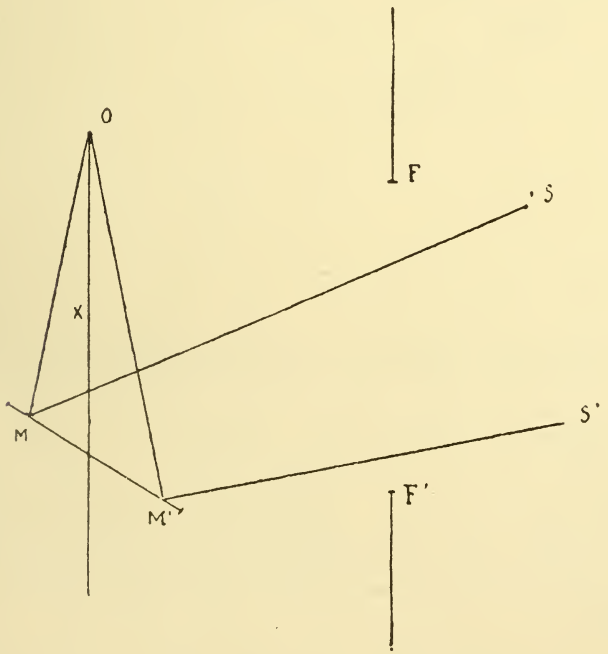
The general problem of illumination is how to cause the luminous rays emitted by a source of light to converge upon the object under a certain angle; but since in every optical apparatus the path of the luminous rays can be considered as reciprocal, it is more convenient to transform this and consider that the problem to be solved is to find the conditions in which all the rays of a pencil emanating from the object under a given angle shall meet a source of light.

As regards the achromatism of the illumination, if all the coloured rays emanating from a point of the object meet the source of light, the illumination of that part will be achromatic; but if this is not the case, it will be coloured by a colour complementary to that of the rays which do not meet the source of light.

Two cases of illumination are considered.

(1) The luminous source has dimensions relatively indefinite. Suppose that the rays of the pencil from the object have an angular aperture sufficiently small not to extend beyond the limits of the mirror MM′ and that their prolongations SS′ passing freely across the window FF′ lose themselves in a clear blue sky (fig. 22). In this case it is evident

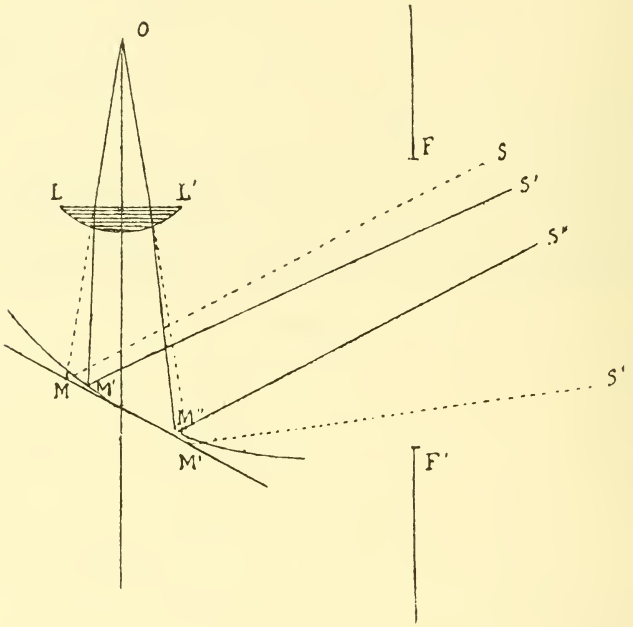
FIG. 22.



that if the rays O M and O M′ always start from the object in the same directions, whatever modifications these directions may afterwards undergo, the effect produced will be the same. Thus, as seen in fig. 23, the interposition of the lens LL′ and the curved mirror MM′ in place of

the plane mirror, in no way affects the final result. Accordingly, whenever the source of light can be regarded as limitless for a given amplitude of illumination, no apparatus, concave mirror or condenser, will produce a different effect to that obtained by the use of the plane mirror alone.

Fig. 23.



This will always be the case when objectives with total angle of aperture less than 30° (No. 1 of Nachet, A of Zeiss, and lower numbers) are used with the Microscope placed before a window widely open on a horizon sufficiently vast, and with the sky free from clouds.

(2) The source of light is limited. This is usually the case, and is caused either by the source being really limited in itself, or by the plane mirror which transmits it being too small to receive all the rays proceeding from the object A condenser is therefore necessary in order to cause all the rays emanating from the object to meet the source of light. The concave mirror is a simple but imperfect condenser, which suffices for low-power objectives. Its angular aperture is about 30°.

For high-power objectives a condenser is required. This forms at a given point a real and reduced image of the source, and the position of the object must be on this image. Here the intensity of the light is at a maximum, and since the object coincides with a source of light, all phenomena of diffraction are eliminated.

As regards the achromatism of the illumination, it is sufficient that

the object coincide with the colourless part of the image of the source. The achromatism of the condenser is therefore so far useful that it augments the extent of the image which can be utilized. The illumination will also be so much more perfect as the image of the source is better defined, so that the result will be more satisfactory if the condenser is aplanatic, if it is well centered, and if it functions in conditions for which the curvature of the lenses are calculated.

The author gives the following practical rules for the regulation of the light:—

(1) Furnish the instrument with a low objective, and, after having centered the condenser, illuminate with the plane mirror and focus the object.

(2) Raise or lower the condenser until the image of the luminous source is seen somewhere in the field.

(3) Make the image coincide with the object by displacing the source of light, or, where this is impracticable, by displacing the mirror.

(4) Exchange the low- for the high-power objective which is to be used, and again focus. Centre if necessary, and displace the image of the source as before.

(5) Remove the eye-piece and look into the body-tube at the image of the aperture; then by means of a diaphragm cause the image of the luminous pencil to occupy about a third of the total aperture.

When a lamp is used, the flame should be turned sideways to the Microscope. When the sky is the source of light, the condenser is focused by bringing into the field the image of some distant object, and then slightly turning the mirror to make it disappear.

If the object is too large to be superposed on the image of the flame, or if it is desired to have a large field uniformly illuminated, the condenser must be either raised or lowered. But in many cases, as e. g. when the condenser is united to the preparation by an immersion-liquid, it is impossible to move the condenser. In these cases a lens known as the *illuminating lens* is interposed between the lamp and mirror. The adjustment of this lens usually offers some difficulty. The mode of operation is as follows:—

(1) With the lamp about 0·25 to 0·30 m. from the mirror, the flame is centered and focused.

(2) The illuminating lens is then placed nearly in the focus of the flame, and centered by making use of the image furnished by its mounting.

(3) A uniform illumination of the field is then effected by slight movements of the lens in its mounting.

These conditions are very difficult to fulfil when the lens is independent of the lamp; but the regulation of the light becomes comparatively easy when the lens is united to the lamp by a special mounting provided with articulations, by which the lens can be moved in two rectangular directions. The most convenient lamp in this connection is that of Beck.

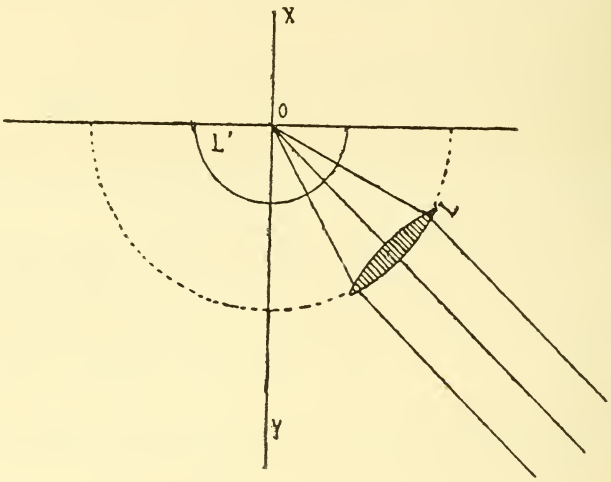
Glasses coloured more or less blue are the best means to employ in order to modify the intensity of the illumination.

For oblique illumination the above rules are no longer applicable. It is necessary to proceed by trial. After having correctly regulated the

central light the diaphragm is shifted little by little out of the centre, and after each movement its aperture is again illuminated by slightly displacing the mirror, or, better, the lamp.

In English and American instruments the oblique illumination is easily regulated by rotating the condenser L about the object itself O as centre. A hemispherical lens L′ placed beneath the object and optically united to the slide by an immersion-liquid, collects, without sensible deviation, the convergent rays from the condenser L, whatever may be the inclination of the latter to the axis $x\,y$ of the Microscope (fig. 24). As a rule the aperture of the illuminating pencil ought not to exceed the third of the aperture of the objective, but cases may occur in which the employment of pencils of large amplitude may be of service, as e. g. when very small coloured particles, dispersed in a feebly transparent but colourless medium, have to be distinguished; for in this case, although when using a very wide pencil the images disappear, yet the opposition of the colour will remain.

Fig. 24.



By employing an illuminating pencil so oblique that it does not enter into the aperture of the objective, the field will be dark, but any particles or objects in the field can so modify the direction of the rays that they penetrate into the objective, and a bright image will be obtained on a dark ground. This method of illumination gives very beautiful effects, but it is only employed with objectives of low or moderate power.

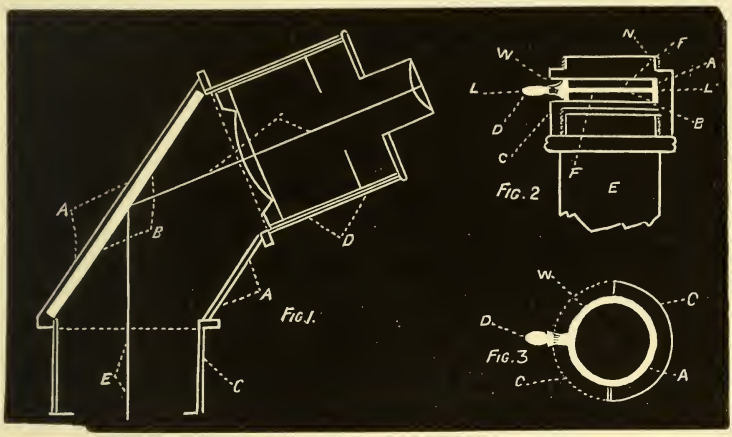
The Analysing Eye-piece.*—Mr. W. Lighton remarks:—"At the first meeting of the American Society of Microscopists, held at Indianapolis, I presented a paper upon an analysing eye-piece, and exhibited one that I had been using for several years. I sent, at a later date, a drawing and description of it to the San Francisco Microscopical Society.

* Amer. Mon Micr. Journ., xiii. (1892) pp. 260–2.

I have had many letters from microscopists since that time asking about the appliance, and I have been strongly urged lately to present the matter through the 'American Monthly Microscopical Journal.'

This apparatus consists of a box A, of the form shown in the side view, fig. 25, 1, made of either metal or wood, and containing a plate of

Fig 25.



polished black glass B. At the lower part of this box is a short tube C, which fits into the draw-tube of the Microscope, and at the opposite angle of the box is another short tube D, which receives the eye-piece. The glass plate is used for the purpose of reflecting the beams of polarized light at the best analysing angle. It will be necessary, of course, to use some form of polarizer below the object upon the stage of the Microscope, and the best is the Nicol's prism.

The line E represents a ray of light which has been reflected by the concave mirror through the Nicol's prism and objective, and is reflected by the polished surface of the glass B through the axis of the eye-piece, as shown by the line F. C represents the eye-piece.

The exact angle of inclination of the polished surface of the glass to the line E, which represents the axis of the Microscope, is very important. This angle should be 146°, which will cause the reflected beam F to form an angle of 112° with the line E, which is the correct angle for a reflector of polished German plate glass, now to be described.

If a piece of black glass cannot be obtained, procure a piece of perfectly polished German plate looking-glass $2\frac{1}{8}$ in. long and $1\frac{1}{4}$ in. wide. Scrape off the silver surface and thoroughly clean. Paint the cleaned surface quite heavily with black paint. Plate glass of a dark-green colour when examined edgeways is best.

A diaphragm with opening about the diameter of the field-lens of the eye-piece should be placed at the lower end of tube C. It is hardly necessary to state that this piece of apparatus is used as an analysing arrangement instead of the Nicol's prism analyser placed above the

objective. The following are some of the valuable features of this arrangement:—

It allows the entire angular aperture of all objectives to be used, which is not the case when using the Nicol's analyser and large-angle low-power objectives. The stage can be kept in a horizontal position in chemical experiments and in the examination of fluids, and the line of vision for the worker is the very convenient one shown at F. The image of very delicate objects is free from distortions, which is rarely the case when using a Nicol's analyser.

The analysing eye-piece can be revolved in the draw-tube of the Microscope by means of the tube C, giving the usual effects of a revolving analyser.

It is well to use a hemispherical lens of about $\frac{5}{8}$ in. diameter above the selenite film and polarizing prism, with the convex side of the lens toward the object upon the stage, and the upper part of this convex surface about $\frac{1}{4}$ in. from the object.

A modification of the revolving mica film, which I described in 'The Omaha Clinic,' to be used with the Nicol's analyser, is of especial value with the above described eye-piece arrangement, and it is represented in figs. 2 and 3. The apparatus consists of a plate of mica placed between the analysing plate and the object upon the stage of the Microscope in such a manner that rotation can be given to it, and it can be instantly removed if desired.

Let fig. 2 represent a side sectional view of the apparatus. C is an adapter carrying the rotating mica plate. E is the objective screwed into the lower part of the adapter. N is the screw for the body-tube of the Microscope. The mica film B is to be cemented between two plates of perfectly polished glass F of sufficient thickness to prevent distortion of image. This disc is to be fitted in the ring A, to one side of which is screwed a small handle D, to be used in giving rotation to the plates B F. A slit W is cut in the side of the adapter C to allow of the necessary motion to the handle D. The amount of this motion is governed by the length of the slit.

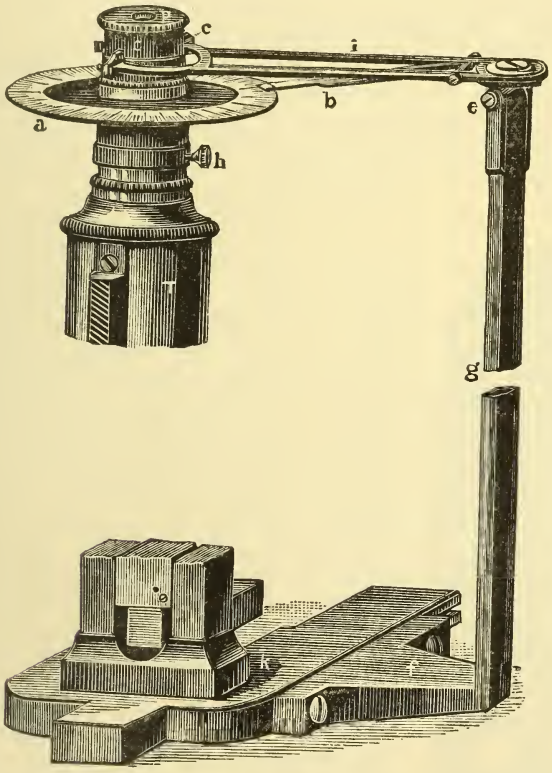
Fig 3 is a top sectional view, as indicated by the dotted lines L L in fig. 2. The letters in figs. 2 and 3 refer to the same parts. It will be seen in fig. 3 that the slit for the rotation of the mica film allows 180 degrees of motion, which is equal in its optical effects to an entire revolution. In selecting mica films great care must be taken to use only those which are free from bubbles, lines, and other optical defects, and are perfectly clear; and the richest effects are obtained when used in connection with a red and green selenite film placed in its position over the polarizing prism, and the mica plate so placed in its plane of rotation to the polariscope that it gives a deep, rich violet colour to the field of the Microscope. This will be the case if the proper thickness of mica film has been selected.

As before mentioned, it will be noticed that the mica film is placed between the analyser and the object upon the stage, and in this position it will be found to give new and beautiful effects, in many cases giving great boldness to delicate structure."

(3) Illuminating and other Apparatus.

Fromme's Arrangement of the Polarization Apparatus for Histological Purposes.*—Prof. V. v. Ebner remarks that the arrangement of the polarization apparatus in the ordinary Microscope is not very convenient for histological work. Means for measuring the angle of rotation of the polarizer, necessary in the case of circularly polarizing substances, is not required for histological work. An indispensable requisite, however, for such work is an arrangement which allows the preparation to be turned through all azimuths between the fixed nicols. The rotating

Fig. 26.



stage-plate with which many polarizing Microscopes are provided is not suited for work with high powers, owing to want of proper centering. A Microscope, however, of which the upper portion together with the stage can be rotated about the vertical axis, allows of the rotation of the preparation between fixed nicols if the polarizer is attached to the lower fixed portion of the stand, and the analyser to a special holder which does not share in the movement of the Microscope.

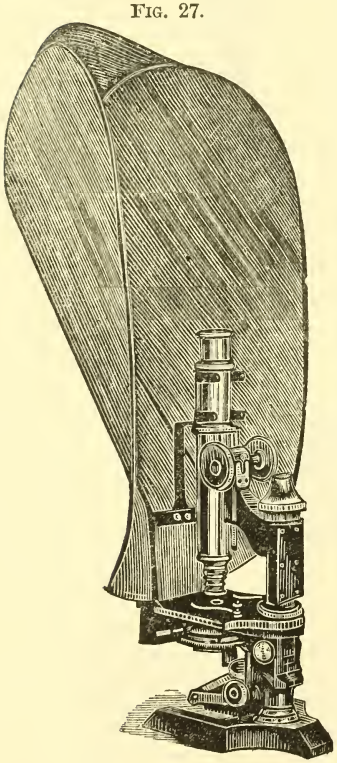
An instrument, answering to these requirements, which was made for

* Zeitschr. f. wiss. Mikr., ix. (1892) pp. 161–8.

the author by A. Fromme, of Vienna, is represented in half its natural size in fig. 26. The metal upright *g* is at its lower end *f* bent at a right angle, and attached to the horse-shoe foot of the Microscope *k* by a slide arrangement so that it can be easily removed or replaced at will. The horizontal arm *i*, at the upper end of the rod *g*, carries two vertical projecting pieces *c*, which fit into corresponding slots made in the fastening of the analyser. The latter, which is simply placed above the eye-piece, therefore remains fixed when the body-tube of the Microscope is rotated. The upright *g* is so far from the stage that the upper part of the Microscope never comes in contact with it during a complete rotation.

If an analysing eye-piece is used instead of the simple analyser, its fastening must be provided with slots in which the projecting edges *c* fit as before. The length of the rod *g* is chosen to correspond to a tube-length of 16 cm. The draw-tube of the Microscope must be used in order to effect the exact adjustment of the arm *i*. The latter can, however, be rotated about the horizontal axis *e* so as to give play for the slow motion. A rotation of this arm about a vertical axis is also possible.

Fig. 27.



For most histological purposes observation of the behaviour of the preparation between crossed nicols is all that is required; but, where necessary, an arrangement can be easily added to the apparatus by which angles of extinction, &c., can be measured. For this purpose cross-wires are fitted in the compensating eye-piece and a circle *a* divided in degrees and half degrees is clamped to the body-tube of the Microscope by the screw *h*. The scale thus turns with the body-tube while the eye-piece and analyser remain fixed. A projecting pointer *b* on the arm *i* serves as index for reading the angle of rotation. It is movable about a horizontal axis near the screw-head of the rod *g* so as to accommodate itself to the movement of the micrometer screw and remain constantly in contact with the divided circle.

In conclusion, the author gives some of his experiences with doubly refracting objectives and condensers. Of a series of new objectives few were found which were quite free from double refraction; but in most cases it was so slight that it could only be recognized by special means. Apochromatics were found to have this fault more than ordinary achromatic objectives.

New Microscope-Shade.*—Herr P. Schieferdecker has devised a new shade for the Microscope for which he claims many advantages. It has the form represented in fig. 27, and

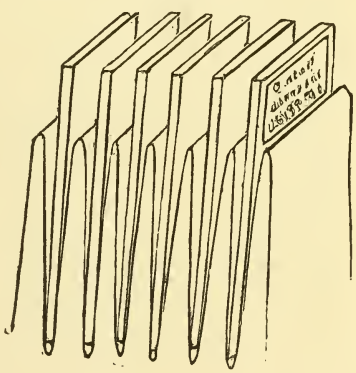
* Zeitschr f. wiss. Mikr., ix. (1892) pp. 180-1.

consists of a light wire frame on which is stretched some light black material. The latter extends a little below the lower edge of the rectangular plate which supports the shade, so that no interval is left on raising the body-tube. The shade serves to protect the eyes from the light, while it is so large that no heating of the head or deposition of moisture by the breath is likely to occur. It is very light and does not in any way encroach upon the working space. Finally, it can be very easily attached and taken off again.

Cheap Form of Box for Microscope Slides.—Mr. G. P. Merrill* describes the following arrangement:—"Presumably no one ever started out with making a collection of slides for the Microscope but has wrestled long with the problem as to how they may best be taken care of. In the administrative work of this department the problem early became a serious one. For its satisfactory solution I am indebted to my brother, L. H. Merrill, then assisting me.

As it happened, we had in stock a number of pasteboard boxes some 93 mm. wide, 143 mm. long, and 48 mm. deep, all inside measurements. The dimensions of our standard slide are 48 by 28 mm. By means of two wooden partitions, some 3 mm. thick, running lengthwise, each box was divided into three equal compartments, the partitions being held in place by glue reinforced by two small tacks at each end. Heavy manilla wrapping paper, such as we also had in stock, was then cut into strips 25 mm. wide and as long as the sheet of paper would allow, in this case about 7 ft. These strips were then bent into a series of folds, as shown in the accompanying illustration, the apices being rounded, not pinched flat. If carefully done, the folds when crowded gently together act as a spring. Two of these folded strips were then placed lengthwise in each compartment, and the slides introduced, standing on end, between the folds at the top. A box as thus prepared readily holds three rows of 50 slides in a row, or 150 altogether.

Fig. 28.



Each slide is separated from its neighbour in the same row by a double thickness of manilla paper, which, owing to its manner of folding, acts as a spring, and avoids all possible danger of breakage. When all the compartments are filled, the space between the tops of the slides in any row is but about 2 mm.; but there is, nevertheless, no difficulty in removing a slide or in getting at it to read the label without removal, since, owing to the yielding nature of the paper, the tops may be readily drawn apart. In this respect the box offers a great advantage over those with rigid wooden compartments, such as are commonly in use. The first box was made merely as an experiment. It proved so satisfactory

* Dept. of Geology, U.S. Nat. Mus. Washington D.C. See Science, xx. (1892) pp. 298-9.

that, for the time being at least, it is the form adopted for storing the several thousand slides forming the Museum collections.

I have attempted to show the arrangement as above described in the accompanying drawing. In reality the slides are held much more firmly than indicated, since the paper bulges and comes against both the front and back of the slides, the full length of the fold, instead of merely at the bottom. It will very likely strike the reader that a better material than paper might be found. I can only state that after considerable experimenting the paper was, all things considered, found most satisfactory."

(4) Photomicrography.

Photomicrography and direct positive Enlargements.*—M. Fabre-Domergue points out the limits to the use of photomicrography as a help to the Microscopist, and shows what advantages a careful drawing made by means of the camera lucida possesses over a photomicrogram; for while the artist in drawing superposes all the planes which he observes by means of successive focusing, the photomicrogram on the contrary only reproduces one of these, viz. that one which was in focus before the exposure of the plate. At present he considers that the questions whether the employment of photography considered as an auxiliary is really useful, and whether time and precision are gained by replacing the camera lucida by the photographic objective, would generally be answered in the negative. He ascribes the discredit into which photomicrography has fallen partly to the reason above stated and partly to the complicated apparatus required. Photomicrography can only be considered as a good method of work if it surpasses that of the camera lucida in rapidity, precision, and convenience, and these qualities he has not met with when he wished to make use of the complicated combination of apparatus now in vogue.

For this reason he has returned to Moitessier's original system and has made use of a small camera adapted directly to the Microscope, which gives small but perfectly clear images. The small proofs thus obtained are then enlarged by some of the new processes which have been lately considerably simplified.

The process which the author advocates therefore consists in the application of new and improved photographic processes to an old method of operation which had fallen into disuse, and of which the only fault consisted in giving proofs too small to be directly used.

He first describes the mode of operation for obtaining the small negative, and secondly the method of enlargement to a positive proof.

(1) *Taking the small negative.*—The camera, which is entirely of wood, consists of a small box pierced below by an aperture, into which fits the body-tube of the Microscope, and closed above by a velvet cover. A shutter of cardboard, containing either a sensitive plate 4 in. by 4 in. or a ground glass, slides in a groove in the base of the box. The ground glass, on which two diagonal lines are scratched, is provided at its centre with a small disc of thin glass cemented to the plate by Canada balsam. Since the refractive index of the balsam is nearly the same as that of the glass, a transparent window is thus formed, by means

* Ann. de Microgr., iv. (1892) pp. 288-99, 569-75.

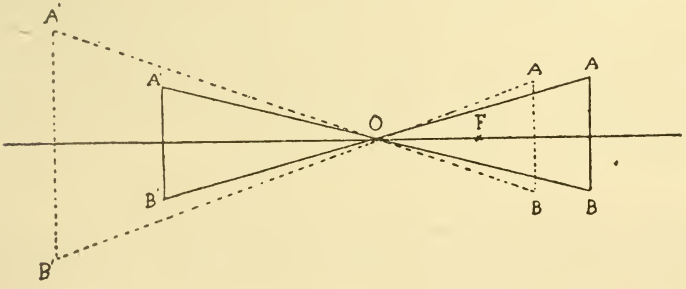
of which the focusing is much facilitated. The method of illumination is either by a petroleum or albo-carbon gas lamp. The amount of illumination is determined by Abbe's method, which consists in looking into the body-tube of the Microscope after removal of the eye-piece, and making the ratio of the bright and darker luminous field thus observed as 1 : 3.

With respect to the choice of preparations, sections should be as thin as possible. The most suitable are those which have been embedded in paraffin and stained with safranin, eosin, hæmatoxylin, &c., and then mounted in balsam. For coloured sections the author prefers balsam to glycerin for mounting.

Two methods of focusing may be employed. The first consists in repeating the operation before each photograph, the second in calculating once for all what displacement the optic system ought to undergo in changing from the eye-piece to the ground glass of the camera. The method of procedure in the first case is as follows:—After removal of the eye-piece and the insertion into the body-tube of the Microscope of a cardboard cylinder coated with black velvet for the prevention of internal reflections, the camera is adjusted on the Microscope. The image is then approximately focused on the ground glass by the micrometer screw. For more exact focusing a lens is employed. The lines traced upon the glass are brought into focus with the lens, and then, looking at the transparent portion of the plate, the micrometer-screw is turned until the image of the preparation is seen with the same clearness as the lines. The second method of focusing consists in determining once for all the lengthening of the body-tube necessary in order to readjust the focus when the eye-piece is substituted for the camera; but for high powers it is scarcely to be relied upon.

As regards the choice of sensitive surfaces, the albumen plates furnish layers absolutely without granulation, but unfortunately they are too slow in action. The author uses Lumière gelatin-bromide plates, of which the fineness is sufficient to allow of enlargements of three diameters without appreciable loss of clearness.

Fig. 29.



(2) *Enlargement of the small negative.*—The principle of all enlarging apparatus is represented in fig. 29, in which A B denotes the surface to be magnified, O the objective, and A′ B′ the sensitive surface intended to

receive the magnified image of A B. If the distance of A B from the objective is double the focal length, the image A′ B′ will be formed at an equal distance on the other side of O, and there will be no magnification. The nearer A B approaches O, the farther from O will the image A′ B′ be formed and the greater will be the magnification. Thus the proper choice of the focal length of the photographic objective is an important point. The author recommends either a very small aplanatic of 8 cm. focal length, or a simple objective of short focus. This is fitted into the middle compartment of a universal camera, the front and back portions of which receive respectively the small negative and the ground glass and slides. Instead of a universal camera an ordinary camera with long draw-tube can be used, though not so conveniently. In this case a cone of cardboard, fitted to the holder of the objective, and provided at the other end with a draw-tube containing the small negative, replaces the front part of the universal camera.

For the production of proofs with the same magnification, an apparatus of constant focus can be very simply constructed on the principle of the enlarging slide of M. Carpentier. This consists of a light-proof wooden box, the bottom of which receives a sensitive gelatin bromide paper while the top carries a draw-tube, in the base of which is inserted a lens which serves as objective. The proof to be enlarged is contained in a box attached to the other end of this draw-tube.

In all these enlarging apparatus the focusing is effected in precisely the same way as in the ordinary apparatus. Daylight is the best means of illumination.

The best way of arranging the sensitive paper in the slide is to place it between two glass plates. In this case the focusing must not be made on the ground glass, but upon a second plate placed against the small transparent window made by the layer of balsam.

When only low magnifications (1 to 5 diameters) of microscopic preparations are required, as e. g. of sections of embryos, brain, &c., which may measure several centimetres in diameter, direct enlargement of the preparation can be made by means of the photographic objective, without the aid of a Microscope. For this purpose the preparation takes the place of the small negative in the enlarging apparatus. It is fixed by two bands of gummed paper to a card pierced by a suitable aperture. Preparations which lend themselves best to this kind of reproduction are those which are a little thick and rather strongly coloured. The author obtained the best results with those which had been treated with hæmatoxylin, decolorized with acid alcohol, washed in alcohol and mounted in balsam. Preparations that are too thin or too feebly coloured should be illuminated by yellow light.

(5) Microscopical Optics and Manipulation.

Index of Refraction.*—Mr. A. B. Aubert describes some of the simpler methods for determining indices of refraction. An instrument for this purpose which he has found to work very satisfactorily is Bertrand's Refractometer, described in this Journal, 1887, p. 469. A simple method, proposed by Mr. Gordon Thompson as sufficiently accu-

* Amer. Microsc. Journ., xiii. (1892) pp. 225–9.

rate for the ordinary purposes of the microscopist, consists in making a fine mark with a diamond on an ordinary glass slide and cementing on each side of it the two halves of a large cover-glass, leaving a space of about 1/8 in. between their edges. The rectangular cell thus formed serves to hold the liquid under examination, and is covered with a very thin cover-glass. The fine mark is viewed with the highest power available, and the difference in focal adjustment for any two liquids examined is a measure of the difference of their refractive indices.

Another simple device for testing the refractive index, due to Prof. H. L. Smith, is also described. The necessary apparatus consists of an adapter about 3/4 in. long, into each side of which a horizontal slot is cut. Through these slots slide two slips of crown glass (2 in. by 1/2 in.) having approximately the refractive index of ordinary cover-glass. A hollow is ground in one of these slips, and serves to hold the liquid to be examined. The instrument is graduated by using different liquids of known refractive index and focusing upon an object through a 1 in. objective, a mark being made on the rack-bar in each case when the focus is perfect. This apparatus was originally devised to test homogeneous immersion media and has been called Prof. Smith's Homotester.

Optical Glass.*—Mr. J. R. Gotz discusses the properties and advantages to be gained by the use of the new glasses for optical purposes. Up to 1885 or 1886, in spite of the experiments of Harcourt and others, the manufacture of optical glass left much to be desired. Up to that time no means had been discovered by which certain errors of achromatism could be eliminated. It was in 1881 that Abbe and Schott first commenced their experiments with a view to the production of new kinds of glass which would allow of the removal of the so-called secondary spectrum.

The success which attended their efforts was attained by the production of improved crown and flint glass, mostly with mixtures of boracic and phosphoric acids, together with the addition of baryta, magnesia, and zinc oxide to obtain greater variations in refractive and dispersive power. Up to the present about eighty different kinds of glass have been put upon the market. These include several series of quite new glasses, such as the phosphate crowns, barium phosphate crowns, boro-silicate crowns, barium silicate crown, borate flint, boro-silicate flint, a special silicate flint, and a light baryta flint.

The catalogue of these glasses indicates for each the refractive index for D, the mean dispersion from C to F, and the proportional or relative dispersion. The variety of these glasses is so great that for almost any special purpose a suitable glass can be found. Some of them are identical with glasses formerly made by Chance Brothers, of Birmingham. For photographic purposes the silicate crowns or flints, and also some of the baryta flints are especially serviceable, but the borate flints are unsuitable owing to the fact that they are injuriously affected by the atmosphere. In this connection the baryta light flints have proved of great value, for on account of the high refraction, lenses of this material can be ground with much flatter curves.

* Anthony's Photographic Bulletin, xxiii. (1892), pp. 624-8.

The author concludes with a brief description of the method of manufacture and mode of testing these new glasses. The making of silicate glass takes close upon three weeks. The crucible is heated during four or five days until it attains a red heat; the inside is then well glazed out with molten glass of the kind to be made. The mixture of substances of which the glass is to be made is then placed in the crucible, thoroughly melted and worked into a homogeneous mass. The glass is then tested, and if in good condition is taken out of the oven and allowed to cool down a little, when it is transferred to another oven where it is left about three days to cool. The crucible is then broken up, and the clear transparent pieces of glass are next subjected to the "setting" process, which consists in heating them in moulds to about the melting point, in a special oven, to which a cooling oven is attached. The cooling takes ten to twelve days. The usable glass amounts to about 20 per cent. of the quantity melted. For special glass a process of fine annealing is used in which the glass is allowed to cool very slowly in a vessel the temperature of which can be accurately measured.

Plane of Polarization and Direction of Vibration of the Light in Doubly Refracting Crystals.*—Prof. V. v. Ebner examines the vexed question of the direction of vibration of plane polarized light. He states as the fundamental data of Fresnel's theory the two following propositions:—

(1) That in plane polarized light the oscillations take place at right angles to the direction of propagation in one plane, which is either the plane of polarization or one at right angles to it.

(2) That the velocity of propagation of the polarized light in a crystal depends only on the direction in the crystal in which the vibration takes place, and not on the direction of propagation.

The first proposition is now undisputed; but not so the second. We know, however, that longitudinal vibrations of the light-waves, at least in the interior of a crystal, do not come into account, for otherwise a rectangular crossing of the planes of polarization could not produce darkness. Further, along one and the same direction in a doubly refracting crystal the faster and slower waves can propagate themselves. Thus the direction of vibration is of essential importance for the velocity of propagation.

Taking the case of an optically uniaxial doubly refracting crystal, the ordinary ray, according to the conventional expression, is polarized in the principal section, the extraordinary in the plane at right angles. In a sphere formed out of such a crystal every diameter will be a possible direction along which the light movement in the crystal can take place. One of these diameters must coincide with the optic axis, and planes through this diameter are principal sections. All these meridional planes are polarization planes of the ordinary ray, and tangents to the meridians cutting the surface of the sphere represent all possible directions of vibration which belong to one of the two polarized light-waves (it is yet undecided to which).

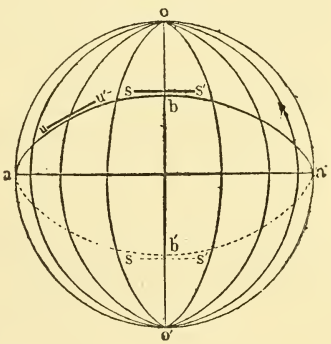
Of the planes of the great circles which are at right angles to principal sections, the equatorial plane is distinguished as cutting all the

* Zeitschr. f. wiss. Mikr., ix. (1893) pp. 289-97.

possible principal sections at right angles. It is at right angles to the optic axis and is the polarization plane of the extraordinary wave when the light is propagated at right angles to the axis. Thus tangents to the equator are all possible directions of vibration of the one wave—whether of the ordinary or extraordinary remains still undetermined. Now, possible polarization planes for the extraordinary wave are all planes at right angles to the principal sections, and of these there can be drawn an infinite number as great circles through a determined diameter of the equator of the sphere. If a diameter to the equator be drawn at right angles to a chosen meridional principal section, and a plane containing it be supposed to be turned through all possible angles about it, the plane in all positions during the rotation remains at right angles to the principal section, and therefore represents in all these positions a possible polarization plane of the extraordinary wave.

Matters are simplified if, instead of the possible polarization planes of the extraordinary wave, we consider the possible directions of vibration in these planes. These directions must, under all circumstances, be at right angles to a principal section, and must therefore be at right angles to the line of intersection of the plane of polarization of the extraordinary wave with a principal section. On the surface of the sphere, therefore, the tangents of the great circles which belong to possible polarization planes of the extraordinary wave, do not all correspond to the directions of vibration in these polarization planes, but only such tangents as stand at right angles to a principal section. In fig. 30 $o\,o'$ denotes the optic axis with principal sections drawn through it which cut the sphere in meridians; $a\,a'$ is the diameter of the equatorial plane; $a\,b\,a'\,b'$ any possible polarization plane of the extraordinary wave; $s\,s'$ the only possible directions of vibration in this plane; $u\,u'$ a direction in this plane, which cannot be a direction of vibration.

Fig. 30.



Now consider the case of a plate of a uniaxial crystal cut at right angles to the optic axis. When this is traversed by a plane light-wave in the direction of the optic axis there is no double refraction, and the light propagates itself with the velocity of the ordinary wave. Since the vibrations are at right angles to the optic axis, their direction lies in that plane of the crystal which exhibits the highest possible symmetry, viz. in the so-called basal plane of the rhombohedral, hexagonal, and tetragonal systems. All directions, then, in such a plane must be regarded as optically similar, since light propagates itself at right angles to planes of this symmetry as ordinary light. In the case of a plate cut parallel or oblique to the optic axis, the ordinary wave polarized in the principal section behaves so far like ordinary light, that it always exhibits the same velocity as light propagated in the direction of the optic axis; while the wave polarized at right angles to the principal section has a

velocity dependent on the inclination of the section to the optic axis; which is greatest (negative crystal) or least (positive crystal) when the light propagates itself at right angles to the optic axis, and is equal to the constant velocity of the ordinary wave when the light proceeds in the direction of the optic axis.

If we accept Fresnel's fundamental data, the constant velocity of propagation of the ordinary wave must correspond to a constant property of the substance in the direction in which the vibration takes place. In the basal plane, however, the vibrations must take place in all directions in the same way, because—as stated above, a plane wave propagated at right angles to this plane behaves like ordinary light, which proceeds in the crystal with the velocity of the ordinary wave.

The only supposition possible is, then, that the vibrations of the ordinary wave take place in the basal plane, and that consequently the direction of vibration of plane polarized light is at right angles to the plane of polarization.

(6) Miscellaneous.

Fifteenth Annual Meeting of American Microscopical Society.—This meeting was held in August last, at Rochester, N.Y., under the presidency of Prof. M. D. Ewell, whose address dealt with some relations of the Microscope and Jurisprudence. Twenty-seven papers were communicated, and six prizes, varying in value from 50 to 15 dollars, have been put at the disposal of the Society. The President for the ensuing year is Prof. Jacob D. Cox.

Scottish Microscopical Society.—This young society has published in a separate form some of its Proceedings, reprinted from the 'Journal of Anatomy and Physiology' (vol. xxv.). The pamphlet is mostly occupied with an interesting address, by Prof. Rutherford, its second President, on the Tercentenary of the Compound Microscope. Prof. Sir W. Turner was the first President, and Dr. Rutherford has been succeeded by Prof. Struthers.

β. Technique.*

(1) Collecting Objects, including Culture Processes.

Coco-nut-Water as a Cultivation Medium.†—Dr. J. N. Daválos opens the nuts in the usual way, pouring the fluid into a vessel, and then distributes it into flasks or test-tubes, which are afterwards discontinuously steam sterilized. If the nut be unripe the reaction of the coco-milk is neutral, but later it becomes acid. If the fluid be made alkaline with soda, potash, or ammonia, a coagulum, which must be filtered off, forms. When the fluid, alkalized and filtered, is steamed under a pressure of $1\frac{1}{2}$ atmospheres it remains clear, but takes on a mahogany colour. This is probably the effect of heat on the glucose.

* 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.

† Crónica Médico-quirúrgica de la Habana, 1892, No. 11. See Centralbl. f. Bacteriol. u. Parasitenk., xii. (1892) pp. 766–9.

The attempt to make agar media with coco-milk instead of meat-broth failed.

The cultivation of micro-organisms shows that on the whole this fluid was a favourable nutritive medium. There was no success with *B. choleræ asiat.*, *B. anthracis*, or gonococci. Most other organisms bred with facility, and the medium seems to afford, in the quantity and form of the sediment, a criterion for distinguishing between *B. entericus* and *B. coli commune*.

Besides these two organisms, *B. mallei*, *B. diphtheriæ*, *B. pyocyaneus*, *St. pyogenes*, *St. pyogenes aureus*, *albus*, and *cereus*, *Diplococcus choleræ gallinarum*, *B. choleræ suum*, and *Vibrio Metsch.* were cultivated with success.

Alkalinity and Liquefaction of Gelatin.*—Dr. Eug. Fränkel has observed that the rapidity of the occurrence of liquefaction, other things being equal, was subject to a considerable amount of variation owing to different methods of preparing gelatin, and that the variable amount of alkali must be considered responsible for these fluctuations in the liquefaction period. The author found that by increasing the alkalinity of the nutrient gelatin the occurrence of liquefaction could be considerably hastened without the characteristic kind of liquefaction being in any way interfered with. It would appear that the optimum amount of alkali to produce the optimum growth varies from 0·5–1·5 per cent. soda, the mean being 1 per cent.

The varying absence or presence of the scum on bouillon and liquefied gelatin cultures is, the author thinks, to be ascribed to peculiarities in the composition of the gelatin, and he states that the different degrees of alkalinity can be produced by using a saturated solution of sodium carbonate.

Chamberland Filter.†—On account of the bad quality of the drinking water in Havana, many families make use of the Chamberland filter in order to purify it. Drs. E. Acosta and F. Grande Rossi have found from an examination of these filters as supplied by the trade that they are quite untrustworthy and are therefore dangerous on account of their supposed safety. For domestic purposes Chamberland filters should be first submitted to an examination; if not, the proper course is to boil the water first.

Beach, B. S.—**Histology, Pathology, and Bacteriology. A Manual.**
Philadelphia, 1892, 165 pp.

Houston, A. C.—**Note on Von Esmarch's Gelatin Roll Cultures.**
Edinburgh Med. Journ., 1892, pp. 552–4.

Schutz, J. L.—**A Rapid Method of making Nutrient Agar-agar.**
Bull. Johns Hopkins Hosp., 1892, p. 92.

(2) Preparing Objects.

Demonstrating Continuity of Protoplasm.‡—Mr. S. Le M. Moore states that a convenient way of demonstrating the continuity of proto-

* Deutsch. Med. Wochenschr., 1892, No. 46. See Centralbl. f. Bacteriol. u. Parasitenk., xii. (1892) pp. 827–8.

† Crónica Médico-quirúrgico de la Habana, 1892, No. 18. See Centralbl. f. Bacteriol. u. Parasitenk, xii. (1892) p. 883.

‡ Journ. of Bot., xxxi. (1893) pp. 51–2.

plasm through cell-walls is by the careful boiling of sections mounted in Millon's fluid. Preparations of endosperm made in this way may, after thorough washing and mounting in glycerin, be kept for years. The application of heat is necessary for only a few seconds.

Demonstration of Intergranular Network.*—Prof. Altmann uses a 2½ per cent. solution of molybdic acid ammonia, plus a small quantity (about 1/4 per cent.) of free chromic acid. In this mixture the fresh organs are left for about 24 hours, then placed in alcohol, and thence into pure paraffin. The sections were stained as usual with hæmatoxylin, gentian, &c.

Blood.†—Dr. A. Spuler investigated the mesenteries of young mice and rabbits, which were spread out on cork plates, and fixed with picro-acetic-osmic acid (1000 ccm. picric, 6 ccm. acetic, 1/2 grm. osmic). After gradations of alcohol, they were stained with hæmatoxylin, Ehrlich-Biondi's mixture, and eosin, and cleared in clove oil.

Bone-cutting Machine.‡—Prof. J. Csokor and Herr A. Csokor have devised a machine which cuts sections of bone thin enough (·12 mm.) to be at once examined microscopically. A circular saw rotates very rapidly; a self-steering arrangement draws the object slowly but persistently against the cutting edge; and there are devices perfecting what is in principle very simple.

Preserving Larvæ of Ascidians.§—Mr. A. Willey finds that the best results are to be obtained by using Davidoff's mixture of 3 parts concentrated corrosive sublimate, and 1 part glacial acetic; the shrinking tendency of the former is neutralized by the swelling power of the latter ingredient.

Examination of Eyes of Arthropods.‖—M. H. Viallanes fixed the eyes of the Crustacea he studied very satisfactorily by means of absolute alcohol; but he prefers a watery solution of sublimate acidified by acetic acid; the proportions he used were distilled water 100 parts, bichloride of mercury 5 parts, and acetic acid 5 parts. After maceration for some hours in this liquid the object was plunged into 70 per cent. alcohol, in which it was left for three or four hours. Perfect depigmentation is very difficult, as all the reagents used are very apt to alter the tissues. The method he recommends is this; take a test-tube closed with a guttapercha cork, pass through this a tube with a ball, twice curved and provided with a mercury valve. At the bottom of the vessel place crystals of chlorate of potash and some drops of hydrochloric acid; this mixture will give off a large amount of chlorine; the test-tube is then placed in a larger tube half filled with a mixture of equal parts of absolute alcohol, glycerin, and water; the cork is then put in. The chlorine is gradually dissolved in the glycerin mixture, and acts on the pigment; this will, in a few hours, disappear completely without affecting the tissues in any way. When the removal of the pigment is complete the piece of eye is placed in 90 per cent. alcohol, renewed as often as is necessary to get rid of the last traces of chlorine.

* Verh. Anat. Ges., vi. (1892) pp. 220–24.
† Archiv f. Mikr. Anat., xl. (1892) pp. 530–52 (1 pl.).
‡ Ver. Anat. Ges., vi. (1892) pp. 270–1.
§ Quart. Journ. Micr. Sci., xxxiv. (1893) p. 319.
‖ Ann. Sci. Nat., xiii. (1892) pp. 354–7.

Staining is advantageously effected by Ranvier's picrocarmine. To study the mode of termination of the nerves in the ommatidium the author recommends a process which consists in forming within the nervous elements a coppery layer of hæmatoxylin. On removal from the alcohol the depigmented piece is put for twelve hours into a solution of 1 per cent. sulphate of copper. This is then washed for five or six hours in distilled water, which is frequently renewed. It is then immersed in a solution which is not prepared till the moment of using it; this consists of 75 ccm. of perfectly distilled water, 25 ccm. of absolute alcohol, and 0·25 grm. of crystallized hæmatoxylin. After immersion for twelve hours the piece is withdrawn, care being taken to avoid the use of any metallic instrument, and it is put at once into a 1 per cent. solution of sulphate of copper; after twelve hours it gives its proper tint. The piece is then washed very carefully for several hours so as to get completely rid of the copper, and it is then dehydrated in baths of alcohol of increasing strength, always kept neutral. The piece is then treated successively with chloroform and paraffin. Sections fixed by the aid of albuminous water are mounted in dried Canada balsam, dissolved in chloroform. Tissues treated in this way have a splendid deep Prussian blue colour, which is almost exclusively confined to the cylinder-axes, the protoplasm, and the nuclei of the nerve-cells; the connective tissue takes such a slight tinge that one can scarcely recognize the nuclei. Unfortunately preparations thus obtained do not last long, even if kept in darkness.

Examination of Sub-cuticular Layer of Ascarids.*—M. Jammes has been able to make some interesting observations on fresh specimens of Ascaris without any other preparation than staining in a watery solution of methylene-green. The best way to fix the cells is to hold a living worm between two pairs of scissors pretty close together, and to plunge the scissors and the piece of the worm between them into a solution of osmic acid, and then with both hands at once to cut through the specimen. Teasing may be effected in a solution containing one-third of alcohol. Besides methylene-green, borax-carmine, acid carmine, Delafield's hæmatoxylin, and others may be used. It is often well to use more than one reagent. On the whole, hæmatoxylin gives the most marked and permanent results. Chloride of gold was also found to be useful.

Method of obtaining Embryos of Balanoglossus.†—Mr. T. H. Morgan finds that Bateson's method, somewhat modified, is the most satisfactory means for obtaining embryos of *Balanoglossus*. Collect the sand around the adults carefully, and allow it to settle in tall glasses filled with water; keep the water in rapid rotatory motion. Siphon off sand and débris. If the young are required in a living state they can be picked out with a pipette. The embryos can be collected much more rapidly by pouring Kleinenberg's picrosulphuric acid, mixed with glacial acetic acid, in 2 to 10 parts per cent. of the whole solution over the sand collected through the siphon. The embryos are quickly coloured dark yellow, and so may be easily and rapidly collected.

* Ann. Sci. Nat., xiii. (1892) pp. 325–7.
† Zool. Anzeig., xv. (1892) p. 457.

Investigation of Freshwater Dendrocœla.*—M. G. D. Chichkoff finds that the best fluid for killing these worms is one containing 2 per cent. bichloride of mercury, 6 parts; 15 per cent. acetic acid, 4 parts; pure nitric acid, 2 parts; 14 per cent. chloride of sodium, 8 parts; and 2 per cent. alum, 1 part. Put some of the fluid in a watch-glass or porcelain dish, take a worm on a spatula in a drop of water, and when it begins to move tip it into the fluid. The animal will die at once, without any contraction. After the worm has been in the fluid for one or two hours put it into 70 per cent. iodized alcohol to remove every trace of the bichloride of mercury; after passing through 80 per cent., 90 per cent., and absolute alcohol, the worm will be ready to be stained. For this purpose boracic carmine was successfully used. Chloroform for ten minutes was used to clear the tissues. The author has observed that if specimens are left for more than twenty minutes in paraffin they cannot be used for sections, as they become brittle, and their histological elements are seriously displaced.

By means of Schanze's microtome sections 1/100 to 2/100 mm. thick were obtained, and were fixed to the slide by Schaellibaum's collodion.

The author claims many advantages for the above method; cilia are perfectly preserved, and epithelial cells are in no way disarranged. In preparations which were to be teased Müller's fluid was used, and was followed by 3 per cent. acetic acid mixed with a few drops of 10 per cent. nitric acid. Teasing is effected in slightly acid glycerin. The isolated parts may be stained by hæmatoxylin or Beale's mixture of carmine and glycerin.

The cellular structure of the epithelium of the pharynx was demonstrated by treatment with a 1/400 solution of nitrate of silver, into which the isolated pharynx was plunged.

Killing and Preserving Rotatoria.†—Mr. C. Rousselet has worked out a successful method of killing and preserving Rotifers in their natural extended state. It consists in narcotizing the animals by adding a small quantity of a 2 per cent. solution of hydrochlorate of cocain to the water in a trough, and when the Rotifers are sufficiently weakened, they are rapidly killed and fixed by adding Flemming's chromo-aceto-osmic acid solution; then, in half an hour, washed in distilled water and put up in an aqueous preservative fluid. The action of cocain is not the same with different species of Rotifers, and therefore the length of time the animals have to remain under the influence of the anæsthetic varies greatly in different species. Distilled water, with only a trace of the fixing solution added, is recommended as the best preservative fluid. Single animals as well as large numbers can be treated at the same time. Rotifers prepared in this way are fully extended, nearly as transparent as in life, with the cilia, muscles, nerve-threads, and all minute anatomical details fully preserved.

Demonstration of Parasitic Protozoa in Cancerous Tumours.‡—Dr. M. Armand Ruffer and Mr. J. H. Walker fixed their material with absolute alcohol, concentrated sublimate solution, or (small pieces)

* Arch. de Biol., xii. (1892) pp. 438-41.
† Journ. Quekett Micr. Club, v. (1893) pp. 205-9.
‡ Journ. of Pathol. and Bacteriol., 1892.

Flemming's solution or osmic acid, washed in water for at least twenty-four hours afterwards, and then hardened in the usual way with alcohol. The pieces were imbedded in paraffin, after the Naples method, before cutting. Biondi's reagent, as prepared by Grübler of Leipzig, proved by far the most valuable stain for cancers hardened in alcohol; one gramme of the powder is dissolved in 80 ccm. of water, and 15 ccm. of a 5 per cent. solution of acid fuchsin is added to it. In a footnote the authors add that Grübler now advises a ·4 per cent. solution of the powder with the addition of 7 ccm. of a ·5 per cent. solution of acid fuchsin to 100 ccm. of the first solution. The sections, after remaining in this solution for an hour at least, are washed in water (30 seconds), and passed through 95 per cent. alcohol (1 minute), absolute alcohol (2–5 minutes), xylol (2–15 minutes), and finally mounted in Canada balsam dissolved in xylol.

The only drawback to such preparations is that the colour has a tendency to fade; they are, however, very beautiful and instructive. The nucleus of the cell is green, the nucleolus reddish-brown or red, and the protoplasm orange-red. On the other hand, the nucleus of the parasite is red, and the protoplasm a light Cambridge blue colour. After using Flemming's solution, Biondi's reagent may also be used.

Solutions of hæmatoxylin and Gerrard's logwood-stain give very fair results, after fixing with osmic acid or Flemming's solution; better preparations are obtained by combining Gerrard's logwood stain with a solution of eosin, or with a ·5 per cent. of rose-bengale in 80 parts of water and 20 parts of absolute alcohol.

Use of Centrifugal Machines in Analytical and Microscopical Work.*—Herr W. Thörner recommends the use of a centrifugal machine for the separation of solid or fluid bodies suspended in liquids which only settle very slowly under ordinary conditions. The apparatus is set in rapid rotation either by a crank, toothed wheels, or a small turbine. The vessel containing the liquids is attached to the upper part of the apparatus in such a way that during the rotation it takes the horizontal position, and at the end returns by steady oscillations to the vertical. The liquids to be separated can also be brought into small glass receptacles fitted into a metal holder which is attached to the plate of the machine. According as the material to be estimated sinks or floats, these receptacles are narrowed in their lower or upper part, and there provided with a scale.

The author has modified the Victoria centrifugal machine, which he has used in his experiments, by the addition of an iron jacket provided with a cover. By this means the enclosed air shares in the rotation and the air resistance is avoided.

Aid to Microscopical Examination of Fæces.†—Dr. Herz uses the centrifuge for separating the different constituents of the fæces. The stools are diluted with water, and after centrifuging, separate into layers, the uppermost consisting of bacteria, thin masses of undigested cellulose, striated muscle, thin layers of round cells, clostridium, starch, &c.

* Zeitschr. f. Instrumentenk., xii. (1892) pp. 390–1. See Chem. Ztg., xvi. p. 1101.

† Centralbl. f. Klin. Med., 1892, No. 92. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 769.

Separation of Micro-organisms by Centrifugal Force.* — Micro-organisms being composed, says M. R. Lezé, of proteids, cellulose, and minerals, are heavier than water, hence if they float in liquids such as wine, cider, milk, this is probably due to the presence of gas; the force necessary to move them up or down in a liquid of specific gravity hardly differing from that of their own protoplasmic body, must be extremely feeble. But this force may be augmented by setting the liquid in motion by means of a centrifuge. The apparatus used by the author were a handworked lactocrite with radius of 9 cm., giving 3600 turns, and a steam turbine (Burmeister's) having a radius of 20 cm. and doing 4000 turns.

In the former the receivers are little tubes drawn out to a conical shape, with the pointed end sealed up. In the second apparatus the action is continuous, so that an indefinite quantity of the liquid can be centrifuged.

In the hand-machine the organisms are chiefly deposited in the pointed ends of the receiver, in the turbine all over the sides, as a sticky gelatinous deposit.

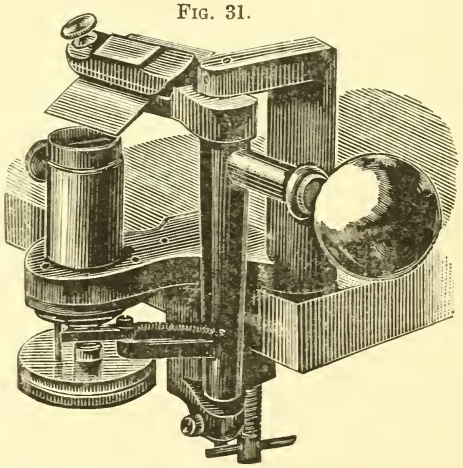
By this method liquids undergoing change of fermentation, &c., may be "separated," and the larger the organisms, the more easily is this effected; thus moulds and yeasts are more easily separated than bacteria.

By diminishing the density of the fluid centrifuging is rendered more easy. This may be done by heating the liquid or adding water, ammonia, alcohol.

(3) Cutting, including Imbedding and Microtomes.

Jung's Microtomes.†—Herr P. Schiefferdecker describes two microtomes constructed by R. Jung. The first instrument is a modification

Fig. 31.



of the English "Cathcart improved microtome." It is made entirely of cast iron, and has the form shown in fig. 31. A strong vertical bar can

* Comptes Rendus, cxv. (1892) pp. 1317–8.
† Zeitschr. f. Wiss. Mikr., ix. (1892) pp. 168–75.

be rotated by the projecting handle on the right between two screw points in the ends of a powerful clamp fastened to the projecting edge of the table. From the upper end of the bar projects a horizontal arm carrying a clamp in which the short knife is held by two screws. In front of the knife and supported by a plate projecting from the base-clamp is a metal cylinder, in which a second cylinder, holding the preparation, is raised by means of the micrometer screw. Jung offers two instruments, differing only in the method of raising the cylinder: in the one the screw is simply adjusted by touch as in the English original, while in the other, represented in the figure, there is an automatic adjustment of the micrometer screw which, though simple in construction, works satisfactorily. The displacement is effected by a pall engaging in a toothed wheel, and its amount, ranging from 10 to 100 μ, is regulated by an adjustable plate provided with a division. The knife is set square and is on the radius of a circle having the axis of rotation as centre. Thus the different parts of the knife will move with different velocities, and as a result there is a displacement of the object towards the parts nearest to the axis of rotation; but this effect is so slight as to be scarcely appreciable. The movement of the knife is very smooth and regular. The lower of the two screws about which the guiding bar rotates can be adjusted when, after prolonged use, the points of the screws have penetrated deeper and deeper into the bar. The instrument is not intended for very delicate work, but for ordinary useful sections of paraffin and frozen preparations.

The second microtome described is a slightly modified form of the "Cambridge rocking microtome," which was described and figured in this Journal, 1885, p. 550. The instrument produces sections which are not simply plane surfaces, but portions of a cylinder with radius equal to the distance of the knife-edge from the axis, and therefore cannot be used for most embryological investigations. Its chief use is for paraffin preparations of histological objects. The author remarks that the instrument can be used with advantage by the pathological anatomist in nearly all cases, but by the normal anatomist only in a restricted degree.

Minot's Microtome.*—Herr P. Schiefferdecker describes a new and improved form of Minot's microtome.† On a metal plate supported by short feet rises a strong upright A (figs. 32 and 33), which carries a slide-way provided with a swallowtail groove. In the figure this is raised so high that it reaches the end of the upright; it carries a second horizontal slide-way in a swallowtail groove, which is moved by a micrometer-screw having at its end the large toothed wheel B. This slide carries on the end turned towards the knife a disc, to which the paraffin preparation is attached. This disc can be turned in different directions by the hand and fixed in any desired position by screws. In the large toothed-wheel B engages a pall which is attached to a movable metal plate fastened to the vertical slide-way. This metal plate projects beyond the pall, and the free end, by the vertical movement of the slide presses against one of the six rays of the star at the side. The pall is thus drawn down and consequently rotates the toothed wheel, by means of which the preparation is displaced. The different rays of the star

* Zeitschr. f. wiss. Mikr., ix. (1892) pp. 176–9. † See this Journal, 1889, p. 143.

allow of displacements of 1/300, 1/150, 1/100, 1/75, 1/60, 1/50 mm. For smaller displacements use is made of the second small toothed wheel C (fig. 33), which by a slight displacement is made to engage in the

Fig. 32.

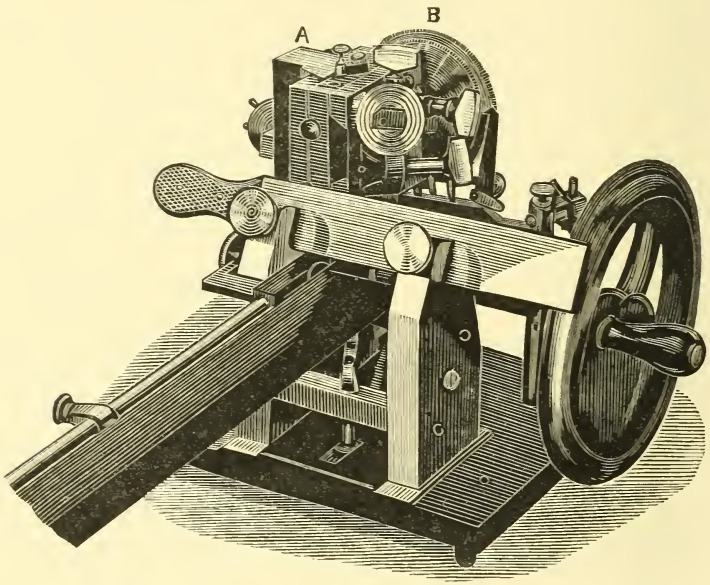
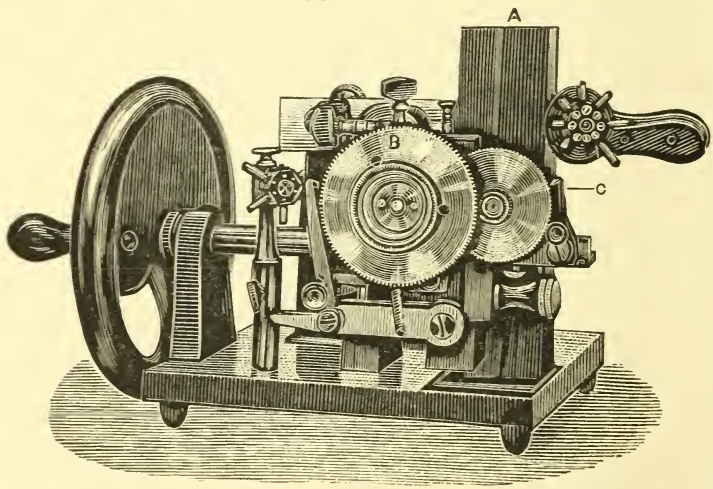


Fig. 33.



large one. By means of the star belonging to this wheel displacements of 1 to 6 μ can be obtained. The knife rests in clefts in two strong uprights, and is clamped and adjusted by two screws.

This instrument has the advantage over the rocking microtome, that

it produces sections all parts of which are in one plane. The sections can also be obtained at a greater rate of speed, and the inclination of the knife can be changed at will. One disadvantage of the instruments lies in the swallowtail grooves of the slide-ways which are not so accurate as those of the rocking microtome. The instrument can be used for all kinds of paraffin sections for normal, pathological histology, and series of embryonic sections. For moist and frozen sections it is naturally not adapted.

A Bacteriological Potato Section Cutter.*—Dr. C. F. Dawson describes his apparatus thus:—"Several methods of preparing potatoes for a culture medium are now in vogue, each having more or less efficiency, and a variable amount of labour.

One of the most common methods is the use of a large cork-borer, or apple-corer, to cut a cylinder from the potato. This cylinder of potato is divided diagonally, thus making two preparations. Pieces of glass tubing are inserted into the thick ends of the two pieces of potato, and they are placed into ordinary test-tubes and sterilized. The pieces of glass tubing serve to support the potatoes above the level of the condensation water, which always settles into the bottom of the tube. In some instances, specially made culture-tubes having a constriction near the bottom of the tube, are used. The constriction supports the potato, and the condensation water falls into the reservoir thus formed in the bottom of the culture-tube.

If the potato medium is to be kept for some time, we find that there is a great change in the form of the potato, due to evaporation of water from it. The inoculation surface becomes irregularly concave, the thin end becomes dry and curls, and the preparation presents an unsightly appearance. When the potato cultures are to be used for exhibition purposes it is desirable to have them present a neat appearance. The aim of the writer is to describe an apparatus which he has devised to prevent the changes in form referred to. The apparatus consists of two pieces: a plugger represented by fig. 34, and a curved knife represented by fig. 35. The plugger is made from a metal tube about six inches long, and of a diameter a little less than the culture-tubes to be used. The side of the metal tube is cut out by sawing slantingly through the wall and across the inner diameter of the tube to the opposite wall at such an angle that the distance traversed by the saw will be about two inches and then by sawing vertically across the diameter of the tube to the wall of the opposite side. The end of the tube nearest the side opening is sharpened from the outer surface, and a wooden handle is fitted into the other end.

The curved knife (fig. 35) is used to cut a convex surface on the potato section so as to compensate for the loss by shrinkage from evaporation. After a time this convex surface will become nearly flat, whereas, if the surface were cut flat at the outset, it would now be irregularly concave.

This knife is made by cutting out a segment of a circular tube of about 1½ in. in diameter, the segment having continuous with it a narrow portion of the wall of the same tube, which portion serves as a handle. The segmental portion is sharpened upon its convex surface.

* Amer. Mon. Micr. Journ., xiii. (1892) pp. 243-4.

When it is desired to make a potato preparation, both ends of a large potato are cut off, and the plugger is passed through it by a rotary vertical movement. The potato cylinder, which appears in the plugger, should be long enough to reach a short distance into the hollow handle, so that it will be held firmly. By passing the curved knife into the potato cylinder and across its diameter in contact with the sides of the opening

Fig. 34.

Fig. 35.

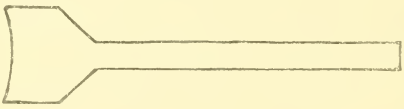


Fig. 36.

in the plugger, the cylinder is divided. The outer piece of the divided cylinder will fall out, and the piece which remains in the plugger now has a levelled surface for inoculation, and it can be removed by pushing it up a short distance into the hollow handle of the plugger.

The thin end of the section should be trimmed off for the distance of about $\frac{1}{2}$ in. to prevent its curling, and a notch should be made in the side of the end of the cylindrical portion of the section to admit the passage of moisture from the water reservoir of the culture-tube to the potato chamber above it. Fig. 36 represents the potato section placed in a reservoir-tube ready for use.

(4) Staining and Injecting.

Staining Bacteria to demonstrate the Flagella.*—Mr. Amos P. Brown writes as follows:—"Among the most difficult objects to demonstrate that the microscopist has to deal with must be ranked the flagella or motile organs of the bacteria. So exceedingly thin and hyaline are they that it requires very skilful manipulation to see them even with the highest angle immersion objectives. Yet by means of staining methods I have been enabled to produce some preparations in which the flagella of *Spirillum undula* may be seen with a 1-in. objective. To see them properly, however, when the forms are as nearly as possible in their natural condition, requires a good 1/5 in. About two years ago I commenced a series of experiments as to the action of various stains on the common putrefactive bacteria, with the especial object of demonstrating the flagella. After trying the methods recommended by Loeffler, Trenckmann, and others for this purpose, I at last developed the following method, which is now published for the first time.

* 'The Observer,' iii. (1892) pp. 298-300.

The process is similar to that used in dying cloth, and consists of two operations, (1) the mordanting, and (2) the staining. The bacteria are placed in a drop of water large enough to nearly cover the cover-glass, when they are allowed to dry spontaneously in the air. Do not use heat to dry the drop, as this deforms the bacteria and often destroys the flagella. The drying process should be watched, and as the last portions of water disappear the cover should be immersed in the mordant and allowed to soak for from two to five hours or more; it may, for instance, be left in the mordant overnight. When culture ovens are available they may be used for drying the drop containing the bacteria, but they are not at all necessary to the success of the operation. After soaking in the mordant for the required time, the cover is transferred to a vessel containing water for about five minutes, to remove excess of the mordant, then it is taken out, drained, and then flooded with the stain. Steam the cover (held in the forceps) for two or three minutes over a lamp, but do not allow it to boil; wash thoroughly in a stream of water, as the jet from a bottle, drain, and set aside to dry spontaneously. Then mount in balsam, preferably that for use with heat, but if using dissolved balsam, put a small drop of oil of cloves, turpentine or xylol in the centre of the cover before lowering the soft balsam. Do not attempt to decolorize in any way, nor to pass through alcohol and oil of cloves to balsam, or the flagella will not remain stained.

The mordant is composed as follows:—tannin 30 grains, anilin oil 12 drops, alcohol 1 fluid oz. This is the normal mordant, but sometimes I find it well to add a little sodic hydrate or hydrochloric acid, one or two drops to the dram, to make it alkaline or acid. A slightly alkaline mordant is best for the large forms *Spirillum undula* and *Bacillus ulna*, which are very common in putrefying water. The alcohol and tannin in the mordant are both fixing agents, and hence the bacteria are fixed without heat, and preserve their shape better than by any other method I have used.

For a stain, any anilin colour, as fuchsin, methyl-violet, dahlia, methyl-green, &c., may be used dissolved in neutral anilin water made by shaking up a few drops of anilin oil in water, adding the stain and then caustic soda until it just begins to precipitate. Then filter and keep well corked. This stain only keeps for a few weeks, so that I recommend the following:—Make a hot saturated solution of fuchsin in water, then add caustic soda until no more red precipitate is formed; filter and save the red precipitate, which is the base rosanilin. A little of this, one or two grains, dissolved in a drop of anilin oil, will make about three or four drams of stain of the proper strength if shaken up with the water. It is often necessary to filter the stain before using. My best preparations are stained with fuchsin; a large series of other mordants, many containing metallic salts, were tried, but after a year and a half's use I still consider this the best.

I would add as a caution to those who may use this method, do not expect perfect results on the first trial; different bacteria require longer or shorter mordanting, and the proper conditions must be determined by experiment in every case."

(5) Mounting, including Slides, Preservative Fluids, &c.

Method for Hermetically closing permanent Cultivations of Bacteria.*—When cultivations of bacteria are intended for exhibition in a museum, the culture-vessels should be hermetically closed. This is usually done with rubber caps or paraffin. The disadvantage of the former is that they become hard and brittle, and the latter may, if the weather become hot, get soft and so sink down.

The method recommended and devised by Dr. C. F. Dawson, which obviates the foregoing inconveniences, is as follows. The cotton-wool plug is cut off flush with the top of the tube with a pair of hot scissors. A circular sterilized cover-glass is then pressed in on the top of the wool so that it just touches the rim of the tube. A thin cake of gelatin which has been lying in perchloride (1–1000) for a short time is then spread firmly over the top and held in position by a rubber band. When the gelatin is nearly dry the superfluous gelatin and with it the rubber band is cut away with a knife. Thus the test-tube is covered in with a circular layer of gelatin, and when this is dry it is further protected with a varnish composed of the following:—alcohol, 200 parts; white shellac, 90 parts; balsam of copaiba, 8 parts.

Medium for Mounting Microscopical Objects which will not mould.†—Dr. A. M. Edwards has devised a medium of high refractive index, and suitable for mounting animal and vegetable objects. It consists of a mixture of saturated solutions of borax, *real* salicylic acid, and oil of cinnamon. The mixture is filtered. The proportions are not given.

Influence of the Composition of the Glass of the Slide and Cover-glass on the Durability of Microscopic Objects.‡—Herr R. Weber, in view of the destruction of microscopic objects through defect or excess of alkalinity in the glass of the object-holder or cover-glass, recommends for delicate preparations a glass especially rich in lime, having a compos tion very similar to that of window-glass.

Mr. G. S. Marryat's Form of Mounting and Dissecting Stand.—The following note by Mr. F. M. Halford was read on Feb. 15th:—"There is nothing new about the simple framework of this stand, which consists of a 3/4 in. pine base-board, 2 ft. 8½ in. by 11 in., on which are raised, in the position shown on plan annexed, two 3/4 in. oak upright supports for the stage and arm-rests. These uprights are grooved at various levels as shown, and the arm-rests are carried down diagonally from the uprights to the base-board.

The stage is 4½ in. by 4¼ in., and of glass, either transparent or opal. When dealing with transparent objects the light is reflected from a small square mirror inclined to the necessary angle and laid on the base-board immediately under the stage. If it is desirable to moderate the light, a square piece of oak with diaphragm of the required diameter is inserted in one of the lower grooves. Four thick elastic

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 720–1.

† Reprint from 'The Omaha Clinic,' Sept. 1892.

‡ Zeitschr. f. Instrumentenk., xii. (1892) p. 388. See Chem. Ber., xxv. (1892) p. 2374.

bands placed transversely on the glass plate forming the stage, spaced so that the two outer ones rest on top of the uprights and the two inner ones will just take an ordinary 3 in. by 1 in. slip, will be found convenient, as by this means the stage and the slip are prevented from moving when pressure is brought to bear on them.

Fig. 37.

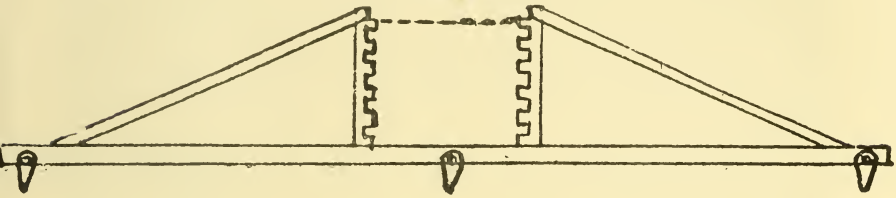
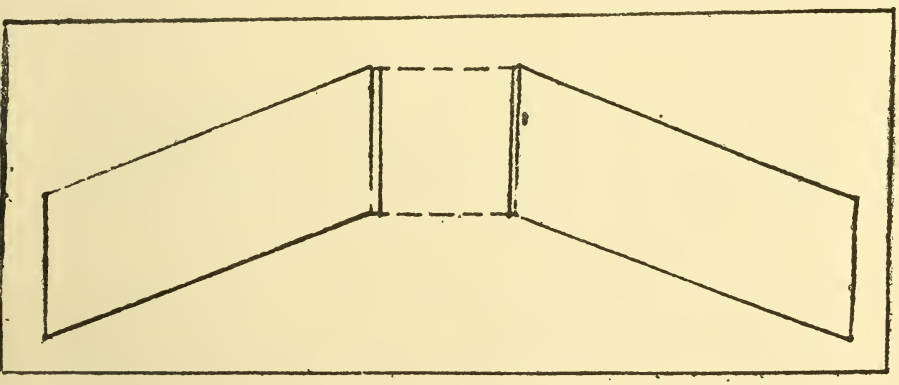


Fig. 38.



For opaque objects the opal glass with elastic bands to take the slip should be used, and the light taken either directly from the lamp or focused by an engraver's globe.

For dissecting under water or other fluid, a square white earthenware trough fitted to one of the grooves should be used; this can be slid in at various heights to suit the object.

When dealing with balsam or other media requiring heat, a brass plate 10 in. long, with a narrow brass tongue 9 in. long, fixed by a nut and screw to the under side of the plate, should be used as a hot stage. The degree of heat can be regulated to a nicety according to the distance from the stage at which the spirit-lamp or Bunsen burner under the brass tongue is placed. The heat is best taken with the tongue at right angles to the plate, as the burner is well out of the way in this position. The tongue folds back under the plate when not in use.

All forms of stages can be fixed securely in the grooves by small oak wedges, and the dissecting trough can also be secured by cork wedges.

Any ordinary lens-holder can be used, but a small rack and pinion,

placed at the back left-hand side of the stage, with jointed brass arm and ring to carry the lens, is the most convenient. For all ordinary work Zeiss's aplanatic lenses × 6 or × 10 are the most useful.

The simple stand can be inexpensively made by an ordinary carpenter or amateur, and many other conveniences and facilities for all kinds of dissecting and mounting work are added in the form exhibited. Such are, small brass tongues on ordinary brass screws turning down and projecting below the front of base-board to prevent the pressure on the stand, when working, from moving it towards the back of the working table. Drawers are fitted below the base-board to hold slips, covers, tools, &c.; small flat boxes with glass lids to hold mounted needles, bristles, brushes, feathers, &c.; spring clips on back to hold pipettes, &c., &c.

The method of fitting and using the hedgehog hairs and bristles, and small pinion feathers of teal, snipe, woodcock, &c., is as follows:—A small cap of quill point is loosely fitted to a pointed handle, the bristle or feather is passed up as far as required and the handle pressed up into the quill; the lower end of the quill may be whipped with waxed silk, to prevent splitting."

(6) Miscellaneous.

Millon's Reagent.*—Mr. S. Le M. Moore recommends, as a better way of making Millon's reagent than the one usually employed, the addition of a saturated solution of mercurous nitrate to an equal quantity of mercuric nitrate as ordinarily sold. No unpleasant smell is caused in the process, and the reagent can be made in any quantity as required.

Forensic Microscopy.†—Dr. L. A. Harding writes:—"Forensic microscopy, like forensic medicine, has a close connection to law; it also deals with cases which are closely interwoven with the administration of justice, and with questions that involve the civil rights and social duties of individuals, the detection of poisons as well as the treatments for the recovery of poison from the poisoned. More and more in the history of the criminal courts is the demand occasioned for the application of the Microscope, and microscopical toxicology . . . If we measure the future by the work and benefits the Microscope has done in the past, it will be seen that a very bright prospect is awaiting us indeed. No instrument yet devised by the ingenuity of man can compare with the Microscope in its universal application to research, and I will endeavour in a brief way to call attention to a few of its special relations to law.

The direct application of the Microscope to law dates back to about 1835, and ever since that time it has made a record for itself in convicting the guilty and protecting the innocent . . . . In the early age of forensic microscopy, its application was simply confined to a few questions of criminal law; but the more it attained perfectness in lenses, the excellent means of determining minute measurements, the adoption of the spectroscope and numerous valuable mechanical appliances, it has claimed so much attention in civil and criminal law that its usefulness cannot be denied. Although the Microscope has played a very important

* Journ. of Bot., xxxi. (1893) p. 51. † Science, xx (1892) pp. 242–3.

part for a number of years in noted criminal and civil cases, its proper relation to law seems to be little understoood. It is true that many underrate its value, and throw aside all testimony attained through its use as worthless, while others again largely overrate its powers . . . . When persons expert in the use of the Microscope are called upon to give testimony, there ought not to be any disagreement as to the result of the examination they may make; as, for instance, if they examine a stain, and blood-corpuscles are found by one, it should be verified by the other; and if measurements of these corpuscles are made, their measures should correspond without a doubt. There should be no difference on such matters of fact, though this is not meant to imply that they should not honestly differ as to how the blood came there. The Microscope will tell with true and unerring certainty whether the adhering substance on a weapon is human or animal hair, or whether what is thought to be hair is not cotton, silk, or wool fibre. It is a well-known fact that portions of brain-substance adhering to weapons which have caused the fracture of the skull and laceration of the brain can only be recognized by the Microscope . . . . In chemistry and toxicology the Microscope is a very important factor for the identification and verification of many ordinary tests, which are made to determine the composition of solids and liquids. Not many years ago, death from poison was surrounded by dread and fear scarcely comprehensible at the present day. Tradition informs us that persons suspected of having committed murder by poisoning were broiled alive in England, and in France burned at the stake, and in the various other countries tortured in the most inhuman manner. It is now, however, generally conceded that, with modern methods introduced for the detection of poison, the fear of discovery has been rendered greater than the dread of punishment. The greatest advance in legal chemistry was through the achievements of Bunsen and others; quantities so minute as to be out of reach of all other known methods of analysis, we are enabled to identify with unerring certainty. Many poisons, such as strychnine, arsenic, morphine, &c., will crystallize with certain reagents into characteristic forms, which are pecular to themselves.

Of late considerable attention has been paid to the microscopical examination of handwritings. While, perhaps, the Microscope cannot be considered an aid in forming an opinion as to the real author of a given specimen, yet its value for the detection of alteration and changes made in the original cannot be underrated. It is impossible to make an erasure of any written or printed lines and hide them from detection by the Microscope; the most skilful forger cannot restore the slighest derangement of the fibres on the finished surface of the paper.

Equipped with the modern improvements and possessing the requisite skill, the progressive microscopist may be said to be a true friend of the curious, in the full meaning of this expression. It is true that sometimes our most exhaustive means of industry and research are only rewarded by negative results; yet it cannot be denied that in the majority of cases we reap the reward of diligence and industry by seeing our work change the whole theory of a plea in civil and criminal actions, becoming a terror to the guilty and joy to the innocent."

PROCEEDINGS OF THE SOCIETY.

Meeting of 15th February, 1893, at 20 Hanover Square, W., The President (Albert D. Michael, Esq., F.L.S.) in the Chair.

The Minutes of the Annual Meeting of 18th January 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 were given to the Donors.

	From
Phycological Memoirs. Pt. 1. (4to, London, 1892)	*Mr. F. Crisp.*
Abstracts of Proceedings; Ormerod's Indices; and Catalogue of the Library	*The Geological Society.*

Mr. A. W. Bennett called attention to the first number of the "Phycological Memoirs," a serial which it was intended to bring out regularly as a record of the work done in the British Museum in the department of Algæ, edited by Mr. G. Murray.

Prof. F. Jeffrey Bell mentioned that in response to an application made to the Geological Society for some portions of their Proceedings to complete the series, the Council of that Society had very kindly forwarded the volumes asked for, together with a catalogue of the books in their library.

Mr. E. M. Nelson exhibited one of Messrs. Watson's Edinburgh Student's Microscopes to which several novelties had been applied (see p. 236).

The President thought this was a very excellent form of Microscope, especially as it was a low-priced one. It seemed to be particularly applicable to the examination of long lines of sections such as were now being so much used. He did not know whether the slide could be passed along without coming into contact with the milled head, as so often occurred where this was not carefully kept below the level of the surface of the stage. In his own work he found he was constantly being brought up by the slide touching the milled head when he had occasion to examine a series of sections.

Mr. Nelson said this defect had been noticed and was obviated in the model before them, where the milled head had been kept just clear of the stage. Though this Microscope was so convenient it did not cost as much with the mechanical stage as a smaller one of similar appearance did without it—the price complete, with the revolving nose-piece, being 11*l.* 10*s.*

Dr. W. H. Dallinger thought these additions were no doubt a great improvement to the original form of this Microscope, which appeared to

be a very serviceable one, especially as the various movements were capable of being easily corrected in the event of wear.

Mr. G. C. Karop thought there was one objection which appeared inseparable from the form of foot, and that was that the milled head was so awkward to find when the stage was inclined. He thought if the foot was made curved instead of straight it could be got at much more easily.

Mr. J. W. Lovibond read the following note on the Measurement of Direct Light:—"Direct light presents a difficulty which does not occur with diffused light, as, whilst with the latter there is no difficulty in defining the general luminosity of the light in neutral tint units of known value, and also the preponderance of any particular colour ray in units of colour value; in direct light there is a penetration of the red ray in excess of the other colour rays which prevents the use of the absorptive glasses which have been graded for diffused light. This disability is evidenced by a development of purity and brightness in the red ray as the light becomes reduced in intensity by the interposition of neutral tint glass standard units. The first impression is to attribute this phenomenon to a preponderance of the red ray in the light itself, or to imperfections in the absorptive glasses; but when we consider that the red ray becomes conspicuous on the absorption of lights, which, under normal conditions produce a distinctive and different colour sensation, it is difficult to account for it on the score of red ray preponderance. Again, considering that on the absorption of diffused light by means of the neutral tint standards no such preponderance in the red ray takes place at all, it can scarcely be attributed to imperfections in the glass standards.

Therefore, for the purpose of investigation, let us as a working hypothesis, consider it as one of *condition*. This idea is suggested by work already done, it having been found that when direct light is transmitted through a diffusive medium, which apparently equally affects all the rays, the excessive penetration of the red ray is reduced in proportion as the diffusive medium is increased in density. An example occurs in nature when sunlight is transmitted through a white fog which is uncontaminated by smoke or other impurities; as the density of the fog increases, the penetration of the red ray is lessened until it attains a colour equivalent with the other colour rays of the light; in this condition it can be gradually absorbed to extinction by means of the glass standard neutral tint units without development of colour.

The apparatus shown to-night is an attempt to measure the excess of penetration of the red ray by means of a graduated scale of artificial fog, which is made by lightly abrading a number of thin slips of colourless glass, and making combinations of them into a graduated scale of 'just perceptible differences.'

The method for microscopical light is to intercept the direct light at the eye-piece with that diffusive combination which permits the total absorption of the transmitted light by means of the neutral tint glass standard units without abnormal development of the red ray.

The diffusive unit value of the combination used may be termed the penetrating value of the red ray, whilst the standard neutral tint units used may be termed the luminous intensity of the light itself. Should the light be a coloured one apart from this condition of the red ray, it can be measured by altering the absorptive glasses in the usual way.

The fixing of a unit value to the dispersive medium is effected by matching each combination with the standard glasses by means of normal daylight of a given intensity. When a match is made under these conditions the vision is unable to differentiate between the two lights, hence it follows that so far as the vision can determine the two combinations are synonymous. But it must be borne in mind that such a diffusive scale is in unit accord with the absorptive scale only so long as the particular light by means of which it was graded is maintained."

Mr. Nelson said that the subject brought before them by Mr. Lovibond was one the history of which was far too long a story to go through on that occasion, but the wonderful results obtained by means of his tintometer were perfectly surprising to any one who had an opportunity of testing its capabilities. It was in fact equal to discovering differences down to millionths of a tint, and having had the pleasure of seeing and using it he soon found that there was a very decided difference in the colour sensation of his own eyes which until that time he had never suspected. It had done such marvels when applied to macroscopic purposes that he did not doubt it would do much also when applied to microscopic studies.

The President said that the value and importance of the subject must have impressed all who had heard Mr. Lovibond's description. It was so important indeed that he could only regret that it had not been brought before them in the form of a paper so that they might have heard fuller details and have had them open for discussion. Unfortunately the time they were able to devote to exhibits was much too short for the consideration of a subject of such great interest.

Mr. Nelson, in the absence of Mr. Halford, exhibited Mr. G. S. Marryat's form of mounting and dissecting stand, and read a short paper upon the subject in which the construction and uses of the apparatus were fully described (see p. 270).

The President thought he should for his own use prefer a rather handier instrument, and one that he could get on every side of. The system of whipping on hairs to handles for mounting purposes was well known, but he usually fixed them simply with a sailor's double-hitch knot which he found very good for the purpose and perfectly tight in use; it was certainly also very much quicker than whipping.

The thanks of the meeting were then unanimously voted to Messrs. Nelson, Lovibond, and Halford for their interesting exhibits.

Mr. T. F. Smith read the following note "On the use of Monochromatic Yellow Light in Photomicrography":—"The former part of Dr.

Piffard's letter on the above subject, read here on 19th October last, contained valuable information for those who using ordinary achromatic objectives photographically have to struggle with the difficulties of the want of identity between the visual and chemical foci of such lenses, and had he finished by describing the happy result when isochromatic plates were substituted for the ordinary ones, there would have been nothing left for me to say; but when he goes on to mix up the question of focus with various light-filters, he seems to me to render difficult a very simple operation, and his remarks subsequently would tend to repel rather than to attract those who wish to record their results by photographing them.

Dr. Piffard mentions his disappointment when using certain lenses on the ordinary wet plates some fourteen years ago, and afterwards on the commercial dry ones, although the same lenses gave a good image visually, and then goes on to say how some ten months ago, when trying a new 1/4 in. on a commercial isochromatic plate, the result was a gratifying surprise. Up to this point there is no reference to any screen, and the perfection of the photographic image seems from the internal evidence of his letter to be due to the use of the isochromatic plate only, but when reverting to the old glasses again, and using them on the same sort of colour correct plates, he finds their performance much better than of old, but still lacking the absolute sharpness desired; and then to overcome this he excludes certain rays by means of a suitable ray-filter, finds the advantage gained by its use very great, but still not equal to theoretic demands; and at this point we are left to struggle with our difficulties as best we may until the author has discovered certain new combinations of light, and certain new corrections in objectives which shall produce the desired result; which will arrive—to use his own words—'When there is an absolute harmony in illumination in lens and in plate, each being adjusted as far as possible to the rays of the same refrangibility.'

Now, working as I have been on the same lines as Dr. Piffard for the last twelve months as far as experimenting on isochromatic plates is concerned, all these refinements of illumination and correction he deems necessary to secure a perfect photographic image certainly fill me with astonishment, having myself found no difficulty in producing a perfectly sharp picture of the object with such plates without using any screen or light-filter whatever, and my opinion is that any such appliances have no effect on focus.

I do not deny that monochromatic light may affect focus to a great extent, when ordinary achromatic lenses are used photographically on a commercial plate not colour correct—indeed we have plenty of evidence to that effect; neither do I deny the advantage of certain screens in rendering colours in the object more or less actinic, All this I admit, but when referring to all the remarks I can find on the subject, I see the authors speak of isochromatic plates only as being used in connection with the light-filters, and argue from it that it is to the latter is due the sharpness of the resulting picture.

I expressed the opinion that there was a confusion here between cause and effect, in a paper read by me in November last before the Quekett Club, but since then, having read Dr. Piffard's letter, I have made special

experiments on the subject, the results of which I beg to lay before you to-night, and although the Podura scale may seem a trite subject, I have chosen it, first because its appearance is known to all microscopists, and secondly, because the slighest divergence of focus is instantly shown on the negative and the resulting prints.

Prints Nos. 1 and 1A to 4 and 4A are taken with four lenses of 1/6 in. focus, two of them under, and two over-corrected, as far as the scale is concerned, and in embracing the two extremes it may be fairly argued that any intermediate correction would produce the same results. Further, to make the selection more comprehensive, one of each correction is an old lens, while the other two are also of opposite corrections, but made partly of the new Jena glass.

Now the quality of the image varies with the quality of the objective, but in all cases the result is the same. No screen or light-filter has been used, but when the negative is taken on an isochromatic plate the image in sharpness is an exact counterpart of that on the camera screen, with no falling away at the edges as described by Dr. Piffard; but when, on the other hand, the negative is taken with the same focus and lighting on an ordinary Ilford plate the image comes out all fluff as shown on the right-hand print on each card.

After experimenting on the four dry lenses, I went on to photograph the same scale with a cheap oil-immerson objective of 1/12 in. focus, using one colour-correct and one ordinary plate as before, but still without any screen, and here, to my surprise, both negatives came out in the same sharp focus. Thinking this might be due to the low magnification used—only 1150 diameters, the same as the others—I took the same scale at 2300 diameters on an Ilford ordinary plate and found that also came out perfectly true to focus. This, I think, is an interesting discovery, and proves that it is possible to make an ordinary achromatic oil-immersion lens of pure correction, which without fluorite shall have the visual and actinic foci identical, no matter what the magnification or what the plate used, whether colour-correct or otherwise. I have tried many oil-immersion lenses—not apochromatic—photographically on ordinary plates, and this is the first I have found correct with high magnification, and I think it only fair to say that the makers of the lens in question are Messrs. Swift and Son. The question may be asked here, why it is not possible to make dry achromatic lenses of great aperture equally true photographically; but I have been told that there are certain difficulties owing to the greater divergence of the rays from a dry objective. This last question, however, does not count if isochromatic plates are used, and these are now so cheap that there is no motive in using any other.

To sum up then, my conclusion from the evidence I have been able to collect is this:—

It is possible to construct an oil-immersion objective without fluorite, the actinic focus of which shall be identical with the visual, without the use of any special plate, screen or ray-filter; but that any oil-immersion lens not so corrected will yet produce a sharp image photographically if isochromatic plates only are used.

Any ordinary achromatic dry lens, whether under or over-corrected, will also produce a sharp photographic image on isochromatic plates—

either with or without a yellow screen; but the image will be likely to be found more or less divergent from that on the camera screen when plates are used not colour-correct.

The fact that certain rays are made active at the visual plane of the objective, when isochromatic plates are used, is due solely to such plates and not to any screen or ray-filter interposed between them.

That I find no evidence of any such refinements of illumination and correction being required to produce a good photographic image as stated by Dr. Piffard."

Mr. Nelson said he should like to ask Mr. Smith if he had tried different kinds of lights in making his experiments; had he tried coloured lamplight or daylight?

Mr. Smith said he had used the light of a paraffin lamp in every case.

Mr. Nelson thought the results obtained were very remarkable and extremely valuable, and he quite endorsed the opinion expressed, but he thought if Mr. Smith had employed sunlight he might perhaps have found that the isochromatic plate would not then select a ray which was sufficiently near to produce quite the same effect. With a paraffin lamp they had a light which, though fairly white, had still a much larger proportion of yellow than was found in sunlight.

Mr. C. Haughton Gill said he could only repeat the observations he made on the former occasion when this subject was before them. Given ordinary isochromatic plates and ordinary objectives the explanation was, not that the plates had corrected the lenses for differences of foci, but simply that such plates were comparatively insensible to the blue and violet rays, but were as sensible to the others. Both lenses and plates being corrected for the yellow—or the visible image—the plate simply made use of the rays which fell upon it, amongst which the blue rays were not sufficiently strong to affect the silver on the plate.

Prof. Bell said they had received some photographs and a letter from Dr. H. G. Piffard, of New York, bearing upon the same subject, which he read to the meeting, as follows:—

"I have received the December number of the Journal, and note the appearance of the letter which I sent you in May last, together with comments thereon. I did not at the time deem it necessary to send photographs illustrating experiments which could readily be repeated by any one possessing objectives whose corrections approximated those described, for I fancied many such could be found in London, especially among those of older make.

The order given to Spencer * for a 1/6 to be specially corrected for D light was filled, and I enclose a few photographs made with it. The lens is a homogeneous immersion of N.A. 1·35. Spencer has also made a 1/15 on the same system for a friend of the writer, and I enclose one photograph made with it (*Amphipleura Lindheimerii*). The visual performance of the lenses is superb. In these two lenses I find the spherical aberration *nil*, or if any exists it is too slight to enable me to determine whether positive or negative. The colour-aberration is negative—slight. A 1/4, more recently made, was brought me by a

* The firm named is Spencer and Smith, Buffalo, N.Y.

friend to verify the maker's statement that it would resolve the *A. pellucida*, which it did clearly and beautifully, using Zeiss comp. ocular 27 to obtain sufficient amplification to enable the resolution to be seen with my hypermetropic and somewhat presbyopic eyes. In order to test this matter still further, I requested the Gundlach Optical Co., of Rochester, N.Y., to make me a low-power cheap lens with similar corrections. This they effected in a 3/4 in. Ang. Aper. 38°; I enclose specimens of its work.

A further test of the principle involved was carried out by the Gundlach Co. by the construction of an ordinary photographic lens of 13 in. equivalent focus, but corrected specially for yellow light. I enclose two samples of its work, copy of an oil painting and a photograph showing the under surface of the horse-foot crab.

I think it will be admitted that up to the time of the late Colonel Woodward photomicrography was in its infancy. The superb work done by him, on the angulatum, the pellucida, the podura, and Nobert's bands was a revelation. As the photographic plate of those days was sensitive only to the more refrangible rays of the spectrum, Colonel Woodward very properly insisted that the best work could only be accomplished by the use of greatly under-corrected lenses. He further insisted on the advantages to be derived from a blue light filter (ammonio-sulphate of copper solution). This appears to have set the fashion of under-correcting lenses generally, for certainly nine-tenths of the modern lenses are so constructed. Now if blue sensitive plates are used, this procedure is undoubtedly correct, but it is at the expense, to a certain extent, of the visual qualities of the objective. Should a colour screen (yellow) be used on such a plate and with an under-corrected lens, nothing would be gained while the exposure would have to be very greatly prolonged.

It seems to me therefore more philosophical to have lenses corrected for best visual performance, and when photographing to use plates sensitive to the strongest visual colour (yellow) and to employ pure monochromatic (yellow) light; or if this cannot be conveniently obtained, to use the best approximation to it in the way of a properly coloured solution.

I do not insist that all photomicrographic work should be done on yellow sensitive plates, but I do believe that these plates, with lenses specially corrected for them, will give better results in most kinds of work (especially histological) than the technique now commonly em-employed.

The photomicrographs were all made by lamplight, using the incandescent lamp devised by the writer and described in the 'New York Medical Journal,' July 16th, 1892 (reprint herewith).

I send an additional podura made about a year ago with a Zeiss 2 mm. apochromatic. I do not consider it equal to the smaller picture made with the Spencer.

The copy of Dr. Arnold's old photograph will supply ammunition to those who believe in 'featherlets' rather than in 'inflations.'"

On the motion of the President, votes of thanks were unanimously passed to Mr. Smith and to Dr. Piffard for their communications.

Prof. Bell said that they had received from Dr. G. M. Giles some deep-sea deposits from the Bay of Bengal, which would be placed at the disposal of any Fellow who wished to make use of it. In his letter Dr. Giles says that "deep-sea soundings are rather difficult material to procure and I thought they might be of value to some Fellow interested in such things as Foraminifera. Will you kindly give them to any one so interested? I have a good deal of marine material by me which I can never hope to work out, notably a quantity of well-preserved surface material (Copepoda, Sagittæ, Salpæ, diatoms, and so on). These are well preserved in spirit and glycerin, but are in no way sorted. If any Fellow would like to take up the job of really working them out, he would be quite welcome to them. They would furnish materials for a series of most interesting papers on the surface fauna of the Bay of Bengal, and I should not care to give them to a mere species-maker; but if you would ascertain if any Fellow would care to take up the study of the collection, I would be most happy to hand them over. They were collected by me when I was Surgeon-Naturalist to the Marine Survey."

Prof. Bell said that a letter had also been received from Mr. G. O. Mitchell, Corresponding Secretary of the San Francisco Microscopical Society, stating that he had sent with it a quantity of diatomaceous earth from Los Angeles in California. This would also be placed in the Library at the disposal of any Fellows of the Society who might wish to take some home for examination.

Mr. Karop said that some of this earth had already been sent to Mr. Morland, Dr. Gray, and Mr. Kitton, by whom it was being investigated.

Prof. Bell also read a short paper by Mr. J. Hood, of Dundee, describing two species of rotifers under the names of *Hudsonia* (*Notops*) *ruber* g. et sp. n., and *Œcistes brevis* sp. n.

Mr. C. Rousselet said that the first of these had, he believed, been already described under the name *Notops pygmalis*. Mr. Colman found it nearly six years ago, and it had been exhibited in that room on an occasion when there was no opportunity for calling attention to it. As it was already named the specific name given to it could not be altered, even if it was to be transferred to a new genus.

Prof. Bell did not think that Mr. Hood had distinguished very clearly in his paper between the generic and specific characters. With regard to the name *Hudsonia*, did Mr. Rousselet think that sufficient reason had been given for constituting a new genus? The species at least appeared to be old.

Mr. Rousselet said it was very much like a *Notops*, and he did not himself think that the reasons given were sufficient for placing it in a new genus. The other rotifer, which Mr. Hood proposed to call *Œcistes brevis*, was new, so far as he was aware.

Mr. G. Western said that if the first species was to be made a new genus, there were some more at present included in *Notops* which would have to be transferred with it.

The President remarked that this was not the first time that an old

species had been described as new; the literature of these things was so wide-spread that it was hardly possible to know at first whether a thing was new or not, but it was a very good thing to have any misapprehension of this kind corrected as soon as possible, and before it got into print, so as to prevent the inevitable confusion which would be sure to otherwise arise. Their thanks were due to those gentlemen who had sent them these communications, and he moved that a special vote of thanks be sent to those who had sent the specimens of deep-sea soundings and diatomaceous earth.

This was unanimously agreed to by the meeting.

Mr. Nelson read a paper "On the Chromatic Curves of Microscope Objectives" (*ante*, pp. 5–17).

Dr. Dallinger said that it would be neither necessary nor wise at that hour of the evening to have much to say upon the very interesting subject before them. The paper was one which was self-contained, and its real value would only become fully apparent when they saw it in print and could read and study it for themselves. Since the use of monochromatic light had been employed by them for microscopical purposes, he had used it in various forms, producing it by different means, both by daylight and lamplight, and nothing could be more remarkable than the results which he had obtained with a series of lenses which had been produced for him by the best English and foreign makers, extending over a period of twenty-eight years, every one of which he still retained in his possession. Many of the results so obtained were as notable as they were curious, so much so that they would require some study on the part of experts to explain them, and the explanation in detail certainly would be most valuable from a practical point of view. Mr. Nelson had been quite right in pointing out that unless we could devise means for employing the shorter wave-lengths of the spectrum, we had approached very near to the limits of visual possibility with the means at present at our disposal. He had not been able in the time at his disposal to go into the details of the explanation of this statement, but they might accept it as a fact, and he thought that what Mr. Nelson had to say in his paper on this subject would clearly demonstrate that it was so. But as to the belief expressed by Mr. Nelson, that glass such as was used in our object-glasses was not transparent to the higher violet and the ultra-violet rays, and to some extent also to the blue, it must be remarked that there could be no doubt but that the figures of the lenses had much to do with this. It led them up to the consideration of the question as to what would be a suitable form and medium for lenses capable of allowing the higher rays to be used. There could be little doubt that all who believed in a future advantage in the use of monochromatic light, also foresaw that there must be lenses specially prepared for its use—wholly adapted, indeed, to the purpose. They all knew now that they had reached the limit of possibility so far as present materials were concerned, for if a lens could be made with a N.A. of 2·00, there was no liquid medium to use with it, but even if they could carry their lenses further they could not mount objects in any media which would give them a further advantage, because no medium

so employed would be tolerant of living or even organic substances. If, therefore, they could by some means use shortened wave-lengths to their fullest possibility, they would have accomplished something extremely useful.

The President was sure all would concur in thanking Mr. Nelson very heartily for the very practical paper he had laid before them. They were, as Dr. Dallinger had said, getting to the end of their tether in one direction, and this being so they must endeavour to see what hope there was in other directions. Possibly, in the first instance they would have to learn to describe colours in some better terms than at present, and instead of speaking of red or blue they would have to express colours in terms equivalent to special lines of the spectrum, so as to be able to get something which could be referred to a certain and absolute standard, and in this way they might get to know the exact colour they were talking about. This seemed to be the first step in the grammar of the matter.

The thanks of the meeting were then unanimously voted to Mr. Nelson for his paper.

The President announced that there were two other papers on the Agenda, but as the authors were not present and the hour was so far advanced, they would be deferred until their next meeting.

The following Instruments, Objects, &c., were exhibited:—

Dr. G. M. Giles:—Deep-sea Deposits from the Bay of Bengal.

Mr. Halford:—Mr. Marriott's Mounting and Dissecting Stand.

Mr. J. Hood:—Drawings of two species of Rotifers illustrating his note.

Mr. J. W. Lovibond:—A Tintometer.

Mr. G. O. Mitchell:—Diatomaceous earth from Los Angeles.

Mr. Nelson:—Messrs. Watson's new form of Edinburgh Student's Stand:—New form of Mechanical Draw-tube.

Dr. H. G. Piffard:—Photographs and Photomicrographs illustrating his letter.

Mr. T. F. Smith:—Photomicrographs illustrating his note.

New Fellows:—The following was elected an *Ordinary* Fellow:—Mr. Martin Ridley Smith.

Meeting of 15th March, 1893, at 20 Hanover Square, W.,
The President (A. D. Michael, Esq., F.L.S.) in the Chair.

The Minutes of the meeting of 15th February 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 were given to the donors.

	From
Report of the British Association, 1892..	*Mr. F. Crisp.*
Microscopical Fauna of the Cretaceous of Minnesota. 4to., 1893	*Mr. B. W. Thomas.*

The President said he thought the Fellows of the Society would be interested to hear that a series of thirty-six photomicrographs had been sent to the Society of Arts in compliance with the request read at the meeting in January last—for exhibition at Chicago. These had been contributed by various Fellows for the purpose, and amongst them was a series of twenty-four enlargements sent by Mr. E. M. Nelson. These had been given by Mr. Nelson to the Society and were sent to Chicago as the Society's property.

A special vote of thanks was, upon the motion of the President, given to Mr. Nelson for his valuable donation.

An electric turntable was exhibited by Mr. Winter, of Messrs. Mawson and Swan, on behalf of Mr. Payne, of Newcastle. It consisted of a brass turntable of ordinary pattern having a small electric motor fitted to its axis beneath the plate, the whole being caused to revolve by the current from a bichromate battery cell. The speed, it was explained, could be regulated by the strength of the current applied, or by the pressure of the finger.

The President said it was certainly a pretty piece of apparatus, and one which under some circumstances might be useful as answering the purpose of the old treadle device of Dr. Matthews to rotate the turntable, and at the same time to leave both hands free.

Dr. W. H. Dallinger said it was not very easy to describe the contents of the remarkable Atlas* which he held in his hand. Those who were conversant with histology might at first sight take them to be some rather bad photographs of organic tissues, although they were really good photographs of some of the results obtained by Prof. Bütschli in the course of his recent experiments. Most of those present were probably aware that Prof. Bütschli had been turning his attention to the preparation of what had been somewhat rashly termed "artificial protoplasm." His procedure might be briefly explained by saying that he first took a small quantity of pure olive oil and kept it in a watch-glass for twelve days at a temperature of 60°—or for a less number of days at a temperature of 80°—at the end of which time it became extremely thick and white in colour. He next transferred a small quantity of this to a mortar, and having added a little powdered carbonate of potash, he breathed upon the surface, supplying thus sufficient moisture to cause the two to combine, the pestle being then used to mix them until they assumed a semifluid condition. Minute quantities of this mixture were then placed upon a glass slip, and a thin cover-glass, supported upon some extremely small feet of wax, was placed over the preparation, and a drop of water was so applied that it and the material would mingle. If this was examined under the Microscope they would, after a lapse of from twelve to twenty-four hours, probably—but not always certainly—find that the whole mass was broken up into minute globules having very much the appearance of a large aggregation of small soap-bubbles in a tub, but being to

* 'Atlas von 19 Mikrophotographien zu O. Bütschli, Untersuchungen über mikroskopische Schäume und das Protoplasma.'

a large extent compressed they frequently assumed a very remarkable tissue-like appearance. When looked at with a low power only, the whole thing looked very much like an organic tissue. If they then put glycerin between the two glasses and managed the experiment properly they would get a kind of cyclosis set up which curiously resembled the circulation which was to be observed in plants. This was all. The observer of living processes knew that cyclosis might suddenly stop and then begin again, or it might stop and then go on in the reverse direction; it was irritable, and was subject to remarkable changes under the influence of electricity. In the so-called artificial protoplasm the movement was all in one direction and it was not susceptible to the same influences, but it was sufficiently striking to be worthy of attention, and if carefully studied these movements would be found to have a meaning which was quite interesting, and might prove of some importance, but he could not suppose that any one looking at these forms would regard them as in any way allied to living matter. The more intimately they became acquainted with them the more sure would they become that they were only foams, and that those which appeared under a low power to be so much like tissue were under a high power seen to be minute bubbles and nothing more. He believed that the movements observed would be found to be due to the effect of differences of surface tension and that the study of them would no doubt help them to understand some of the mechanical properties of protoplasm, but they did not leave an impression that they had caused an approximation in the least degree towards the artificial production of protoplasm in a living state or that contained in itself the potentiality of what could become living.

Mr. R. T. Lewis said he had placed under the Microscope for exhibition some specimens of the pupæ of a new species of *Aleurodes* which was found upon the leaves of asparagus in Natal. The *Aleurodes* were a family of Homopterous insects which had been described as intermediate between the Coccididæ and Aphidæ. In the adult stage they were readily distinguished from either as both sexes were possessed of four wings, but in the larval and pupal conditions they were not so easy to distinguish. The pupæ were generally more or less covered with a waxy secretion exuded from numerous pores or tubes, often presenting a very ornate appearance. There was only one genus, and the species had hitherto chiefly been named from the plants on which they were found. It was therefore proposed to call the new species exhibited that evening *Aleurodes asparagi*. As would be seen from an inspection of the specimens and of the drawing exhibited, it was an extremely pretty object under the Microscope, but at present no complete description of it was possible, as only the pupa form was yet known.

The President said this added another form to a very interesting family, which were not only remarkable for their elegant appearance, but were extremely curious on account of the special glands by which this waxy secretion was extruded.

Mr. T. F. Smith read the following note "On Monochromatic Yellow Light in Photomicrography":—"After reading my note on this subject at the last meeting in answer to Dr. Piffard's letter, it

was suggested to me in private conversation, that as I had used but one maker's lenses for my experiments it was not exhaustive enough, and that I might find the lenses of other makers give a different result. Feeling the force of this, and knowing the danger of generalizing from the particular, I applied to my friend Mr. E. M. Nelson to see if he could help me in this matter, and out of his splendid store of object-glasses lend me a selection of what might be called representative glasses. This he has kindly done and by their help I have been able to push my experiments to what I trust is a definite conclusion. The glasses used are the following:—

1/4	in.	Ross	date	1836,	N.A.	·38,	Initial Power	40
1/4	„	Powell	„	1841	„	·5	„ „	48
1/12	„	Ross	„	abt. 1850	„	·81	„ „	128
1/6	„	Hartnack	„	1872	„	·9	„ „	67
2/3	„	Powell	„	1873–6	„	·28	„ „	151½
1/12	„	Powell, W. F.	„	1877	„	1·2	„ „	135
1/5	„	Gundlach	„	1882-5	„	·88	„ „	54

The subjects chosen are the podura scale, *P. angulatum*, and the proboscis of blow-fly, according to the N.A. of the glasses used, but in all cases the results are in accordance with my former experiments. No screen or light-filter has been used, but the image always came out true to focus when an isochromatic plate was used, but more or less out of focus when a plate was used not colour-correct. I had but little hesitation before, but I have none now in asserting that the owner of any ordinary achromatic objective can produce, photographically, an image on the same plane as the visual rays, and that without any adjustment for focus or the use of any screen, provided always that he uses isochromatic plates."

Prof. Bell read the following note on A Simple Illuminator for the Microscope, received from Dr. A. M. Edwards, of Newark, N.J., U.S.: —"The plan of an illuminator for the Microscope was suggested by Dr. R. L. Maddox in the Journal of the Royal Microscopical Society, 1890, p. 101. In it he uses a prism of glass ground down and placed beneath the object. I use what I believe to be cheaper, that is to say, a piece of glass rod such as is used by chemists for stirring solutions. A piece of glass rod, about 1/4 in. thick, is cut off about 1/2 in. long and ground, as it can be done on a stone hone, on the broken edges. It is also ground down along the flat to about 3/8 thick, that is to say, one-quarter is ground off, and as I use a fine hone a finely ground glass results. This is cemented by gum thus and oil of cinnamon, which is the common varnish of preservation I use now, to the under side of a common glass slide. But the slide is prepared first; it has a coating of diamond dye of a dark blue colour put on first; this must not be too dark but dark enough to tint the light bluish. This is used with oil of cinnamon between it and the slide with the object on. And the illumination is with a kerosene oil lamp; perhaps an electric lamp is better, but that is expensive. I want to cheapen all the apparatus of the Microscope I can. This makes a good illuminator and,

when used with a fifteen cent lamp, which is quite as good as can be got, it makes an excellent instrument."

The thanks of the meeting were given to the authors of these communications.

Surgeon V. Gunson Thorpe's paper "On the Rotifera of China" was then read by Prof. Bell (see p. 145).

Prof. Bell said that this paper was placed upon their Agenda at the preceding meeting, but was unable to be taken then from want of time at disposal, and it seemed too important to pass over, as it formed a valuable addition to their knowledge on the subject.

The President said they were often inclined to envy those who had the opportunities of seeing these things in their native conditions, and the paper to which they had just listened must have made many of them wish that they were able to see the living specimens instead of having to be content with the drawings and descriptions.

Mr. C. Rousselet said it was very difficult to criticize such a paper from simply hearing it read, but he thought Mr. Thorpe was certainly very fortunate in being able to explore such virgin ground as China in search of these objects. Hitherto it had been thought that the distribution of the Rotifera was so general, since even in America and Australia no particularly new or striking forms had been met with, but here Mr. Thorpe seemed to have come across some which were so remarkable that new distinctive characters were required to bring them within the genera already known. If those gentlemen who, like Mr. Thorpe, had these opportunities, would devote some of their spare time and attention to the objects within their reach no doubt many more new forms would reward their efforts.

The President regarded this communication as one of special interest which they would be very glad to see in the Journal.

A vote of thanks to Surgeon Thorpe was unanimously passed.

Dr. G. M. Giles's paper "On certain Cystic Worms which simulate the Appearances of Tuberculosis" was read by Prof. Bell.

Dr. R. G. Hebb said, in reply to a question from the President, that he had never met with any of the worms described, in England, but he had, he believed, read of instances of nematoid worms being found in the human subject, and thought there was a record of the fact in the Journal of the Society, in a paper by Dr. Heneage Gibbs. He had found nodules in the lungs of sheep, and although unable to find the worm he had supposed it to be the cause of what he found. He did not think it was met with in the human kind.

Prof. Bell thought that what Dr. Giles had said in the beginning of his paper was of considerable importance, because if the large number of animals which were killed as being tuberculous were really not so it might be possible to prevent their destruction. There was, he imagined, a general dislike amongst most persons—except such as were fond of high game—to eating meat which swarmed with parasites of any kind. If it was correct that the cattle in India, which were reputed to be

highly tuberculous, were not so, it was very important that the fact should be made widely known.

The President regarded this as a very important paper and one which might have a very wide bearing in the direction suggested by Prof. Bell. With regard to the dislike which was felt to eating meat affected with bacteria, he was disposed to think that not many persons would be found more anxious to eat meat affected with cystic worms, than if it were proved to be really the subject of tuberculosis.

The thanks of the meeting were unanimously voted to Dr. Giles for his paper.

Dr. A. C. Stokes's paper "On new Brackish-water Infusoria from the Eastern part of the United States" was communicated by Prof. Bell, who said that it was illustrated by well-executed drawings, but being largely descriptive was scarcely so suitable to read at a meeting as it would be to appear in the Journal. It was therefore taken as read.

The following Instruments, Objects, &c., were exhibited:—

Dr. W. H. Dallinger:—Prof. Bütschli's Photomicrographs of "Artificial Protoplasm."

Mr. R. T. Lewis:—*Aleurodes asparagi* sp. n.

Mr. Payne:—Electric Turntable.

Mr. T. F. Smith:—Photomicrographs of Podura and Blow-fly's tongue in illustration of his note.

New Fellows:—The following were elected *Ordinary* Fellows:—Mr. Charles Theodore Methew, Rev. George Hay Morgan, and Mr. Frederic William Richardson.

The Journal is issued on the third Wednesday in
February, April, June, August, October, and December.

1893. Part 3. JUNE. { To Non-Fellows, Price 6s.

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
J. ARTHUR THOMSON, M.A.,
Lecturer on Zoology in the School of Medicine, Edinburgh,

FELLOWS OF THE SOCIETY.

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TO BE OBTAINED AT THE SOCIETY'S ROOMS,
20 HANOVER SQUARE, W.;
OF MESSRS. WILLIAMS & NORGATE; AND OF MESSRS. DULAU & CO.

PRINTED BY WM. CLOWES AND SONS, LIMITED [STAMFORD STREET AND CHARING CROSS.

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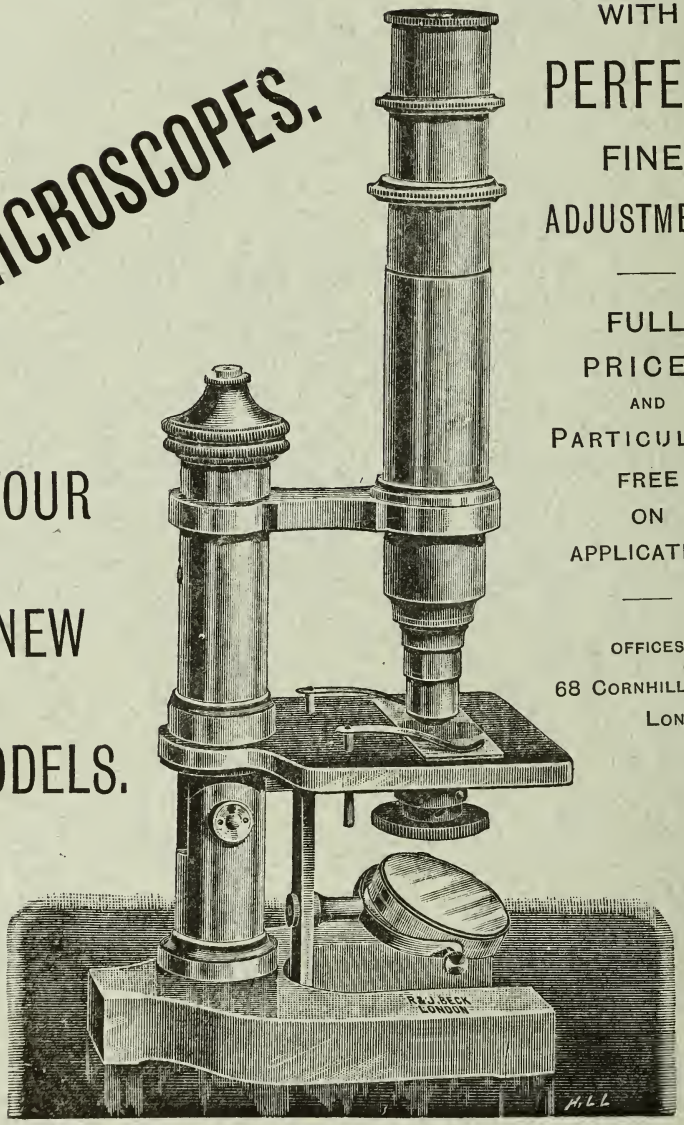

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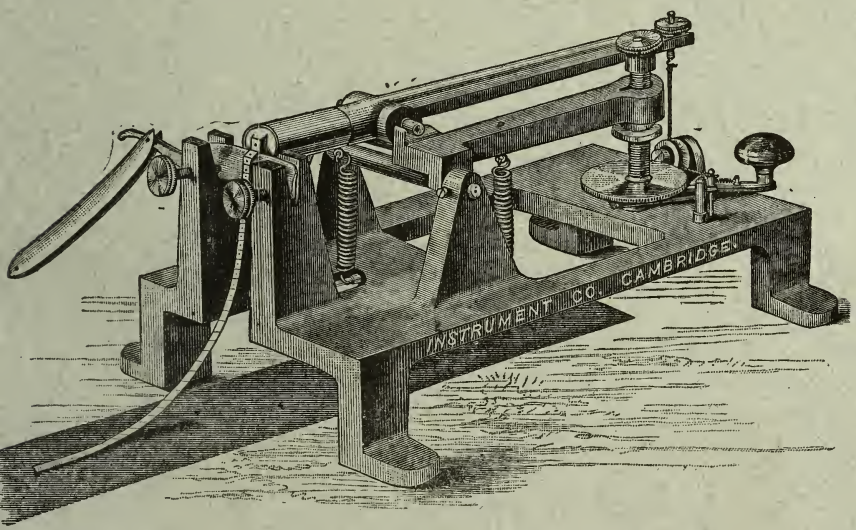

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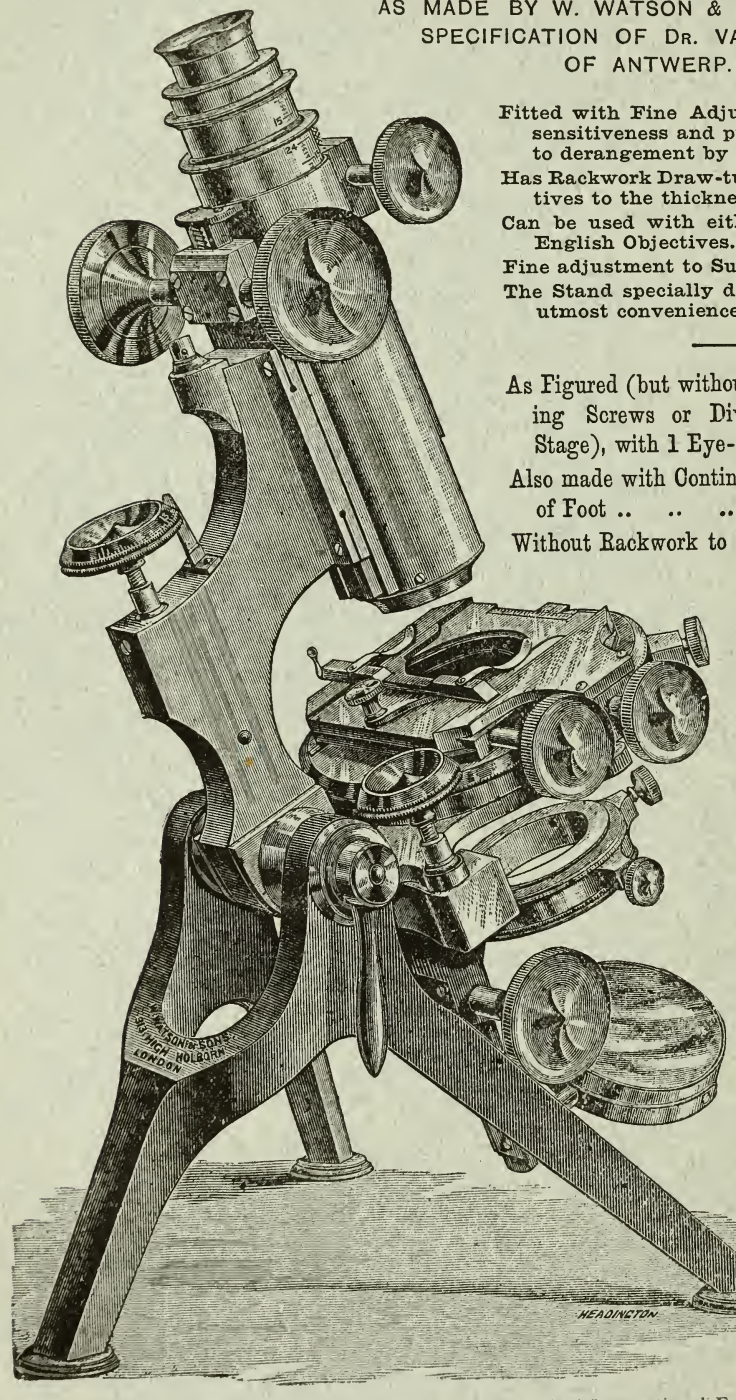

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JOURNAL
OF THE
ROYAL MICROSCOPICAL SOCIETY.
JUNE 1893.

TRANSACTIONS OF THE SOCIETY.

V.—*On Certain Cystic Worms found in Butcher's Meat, and in Equine Animals, which simulate the Appearance of Tuberculosis.*

By G. M. Giles, M.B., F.R.C.S., F.R.M.S., Surg.-Major I.M.S.

(*Read 15th March*, 1893.)

Plate IV.

Of late, since the infectiveness of tuberculous meat has been established, the detection and discrimination of tuberculous lesions in the solid viscera of animals slaughtered for food has become a matter of considerable commercial and hygienic importance. The balance of experimental evidence may waver, but that the consumption of tuberculous meat is a most risky dietetic experiment few would care to deny, and hence the growing popular demand for the destruction of all tuberculous meat is not only natural, but justifiable.

Under these circumstances, it may be well to draw attention to certain lesions not uncommonly met with in sheep, oxen, and equine animals which, though entirely differing from bacillar tuberculosis in

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EXPLANATION OF PLATE IV.

Fig. 1.—Section of liver of mule, showing four nematode tubercles. Zeiss A, Oc. 2.

Fig. 2.—The same, under Zeiss C, Oc. 2. In the centre of the field is the tubercle, and quite in the centre of this may be seen an obliquely-cut piece of the nematode embryo. These two specimens were stained with gentian-violet, which leaves the structures of the tubercle comparatively untinged.

Fig. 3.—Section of lung of sheep, showing a cestode tubercle placed just beneath the pleura which bounds the section above. The magnification is too small to show the embryo, whose position is indicated only by a hazy light spot placed about a quarter of an inch beneath the most prominent portion of the projection formed by the tubercle on the pleural surface. Zeiss A, Oc. 2.

Fig. 4.—To show the general surroundings of the embryo in Fig. 5. Less magnified.

Fig. 5.—Section of liver of sheep, showing a living cestode embryo, which is seen as a tolerably sharply outlined pear-shaped body, placed exactly in the middle of the field, and, as seen in the photograph, about a quarter of an inch long by a rather less diameter. An interlobular vessel is seen close below it, while a short length of the branch on which it is placed may be seen leading up to its broader end. The three latter specimens were stained with borax-carmine.

origin and significance, yet so closely resemble the most characteristic lesions of the latter disease as to be almost indistinguishable, save to careful microscopical examination.

To what extent the cystic worms which cause these appearances may be found in England, I am unable to say; but in India, at any rate, they are very common, far commoner indeed than instances of true tubercle, which, fortunately for us, are but rarely to be met with. Wherever found, however, an ignorance of their true significance might easily lead to the destruction of large quantities of perfectly wholesome food. Anything affecting food-supply is a matter which is of interest to all, and this circumstance, together with the fact that the appearances are due to a curious and but little known phase in the life-history of these Entozoa, of the broadest general biological interest, may compensate the Society for the introduction of certain pathological details inseparable from helminthological studies, but which, by the avoidance of technicalities, I hope to make sufficiently intelligible to all.

To a pathologist it would suffice to say that the appearances in question closely resemble those of miliary tuberculosis, but for the general reader it may be well to premise that these minute helminths reveal their presence to the naked eye as small greyish or yellowish-white nodules, from the dimensions of a pin's head and upwards in size, scattered through the substance of the lungs and liver, and occasionally of the spleen. Any one who has seen a section of the last-mentioned organ, must have noticed the small whitish bodies known as Malpighian bodies. Now, the tubercles I am about to describe resemble these bodies so closely, that their detection in the spleen is a matter of the greatest difficulty, and this resemblance may serve as a guide to those searching for them in other organs. I have, indeed, often met with portions of sheep's liver which might easily have been mistaken for a morsel of spleen to the casual glance of a naked-eye anatomist. The worms which give rise to these appearances in sheep and oxen are cestode embryos; those that give rise to closely similar appearances in the solid viscera of equine animals are immature nematodes. The exact species in each instance is a matter of uncertainty, though I have little doubt that the cestode tubercles are mostly due to *Tænia echinococcus*.

The cestode tubercles found in ruminants are much more common in sheep than in oxen. Out of 110 sheep examined I found the condition under discussion to be present in the livers of 32 and in the lungs of 12. Unfortunately, I have no note of the relatively numerical proportion of its prevalence in oxen, but it is certainly far less frequently met with; while the reverse is the case with cystic worms which have developed sufficiently to constitute definite cysts, and which are of course excluded from the above enumeration.

The number of tubercles present varies greatly, from a few only, scattered at such rare intervals that it would be hardly possible to

confuse the condition with true tubercular infection, to numbers so enormous that the tubercles are rather too closely packed to be typical of the condition they mimic. In one instance so enormous were the numbers, that, putting aside such embryos as had developed sufficiently to simulate the macroscopic appearances of tubercle, others, which had too recently arrived to set up the protective proliferation that forms the tubercle, were so numerous that hardly a section could be found which did not exhibit two or three of them: this though the sections were of but small area.

No helminthological fact can be more striking to the student of human pathology than the kindly way in which herbivorous animals tolerate the invasion of their solid viscera by cestode embryos. Large cysts, which would cause serious, if not fatal illness in the human subject, seem to cause little or no inconvenience to ruminant hosts. The walls of the protective cysts seem to be, one might almost say, instances of physiological proliferation rather than of inflammatory action, and there is commonly nothing whatever to show that the health of the animal has been in any way affected. This is especially the case with the liver. In the lungs, a more or less distinct zone of redness surrounds each tubercle; and where they are numerous, a sort of verminous pneumonia may be set up, but even here any free spaces that may be left uninvaded appear but little altered.

The nematode tubercles were found in the livers of mules which were destroyed owing to their being reduced to a hopeless condition by enormous numbers of *Sclerostomum tetracanthum*, free, and encysted in the intestinal submucosa. It is only quite lately that a renewed examination of the material I collected more than two years ago has established their nematode origin. At the time I first observed them, I believed them to be cestode tubercles identical with those with which I was already familiar in cattle. In spite of the essential difference in the species originating the two sorts of helminth tubercle, it will, I think, be better to take their description together, as their resemblances or differences may thus be more easily emphasized with fewer repetitions than would be otherwise possible.

In either case these helminth tubercles are, as I read the appearances, produced by the lodgment in a minute vessel of an embryo, which, being too large to pass, obstructs the vessel.

The cestode embryos at first grow rapidly, and soon dilate their vascular sheath so as to alter it out of all recognizability.

The nematode embryos do not appear to grow at all in their new lodgment, but their presence, equally with that of the cestode embryos, sets up a proliferation of the tissues of the vascular wall, and perhaps also of the cellular elements of the contained clot. In their case, however, the vascular wall remains—altered, it is true, but still recognizable, and from this difference in their behaviour to their surroundings there results a difference in their appearance which,

though hardly appreciable to the naked eye, is easily recognizable under a comparatively low amplification. The persistence of the vascular wall in the nematode tubercle causes it to retain a sharply defined outline, which is quite wanting in that of cestode origin. Under a higher power, however, the histological resemblance between the substance of the two forms of helminth tubercle to each other, and to true tubercle, are still sufficiently striking. Nor is this at all surprising when it is remembered that all three are merely reversions of the more specialized forms of connective tissue to embryonic characteristics under the stimulus of the presence of parasitic organisms, widely different though the latter may be.

With suitable staining methods, there can, of course, be no possibility of confusing the three forms. It is almost needless to remark that no schizomycete organisms such as characterize true tubercle, are to be met with in the helminth tubercles; while, on the other hand, a sufficiently complete series of sections of the latter will never fail to exhibit, somewhere in the series, a characteristic embryo, cestode or nematode, as the case may be.

In cestode tubercle of the liver, where the embryo has but recently been deposited in that organ, the vascular origin of tissues forming the tubercle is generally quite obvious. Often the vessel can be traced up to the embryo, and its walls may be seen, spread out, and stretched over the intruder.

This is tolerably well shown in the last of the series of five microphotographs which illustrate this note. The embryo is placed almost exactly in the centre of the field, and the portal venule in which it is lodged may be traced up to it tolerably clearly, although it is placed not in the venule which forms so prominent a feature of the section, but in a smaller branch lying close beside it. As may be judged from the small amount of tissue proliferation around it, the embryo, in this instance, has hardly reached the stage in which it would form a nodule visible to the naked eye; a later condition is illustrated in the section of lung (fig. 3) where the gradual fading off of the infiltration surrounding the embryo is well shown. Contrary to what might be expected, the embryos forming the nuclei of these obvious tubercles are, as a rule, in no way notably larger than that illustrated in fig. 4. While, too, the latter embryo has obviously been killed only by the alcohol used to harden the specimen, the embryos contained in the distinct tubercles are, so far as I can ascertain, always breaking down, and have clearly been dead for some time before the death of the host. It is noteworthy too, in this connection, that I have never met with any transition stages between the helminth tubercle and the true cystic tumour. The fact is, I take it, that, while living, cestode embryos of the size of those under discussion do not set up sufficient reaction in the tissues around them to form a sufficiently large patch of altered tissue to be visible to the naked eye. When they die, however, they act as foreign substances, and

set up the patch of tissue reaction which forms the tubercle, and which doubtless persists until the complete breaking down and solution of the tissues of the dead intruder puts an end to the cause of irritation. Of the enormous numbers of cestode embryos that must often gain access to the solid organs of ruminants, only a very small percentage ever survive to develope into viable cysticerci, and the few that do never give rise to appearances at all comparable with the peculiar lesion now described. The use of the term "cestode tubercle" is not without precedent in the writings of Leuckart and others, but, so far as I am aware, the above explanation is now advanced for the first time.

As already remarked, I am doubtful as to the precise species which is responsible for this condition. At this stage, one cestode embryo is pretty much like another, and the particular species of cysticercus into which it is going to develope is more a matter of conjecture than anything else. It may, however, be taken as tolerably certain that the adult worm is a canine parasite. Now, as far as a limited number of examinations go, the tæniæ found in dogs in this part of the world are *Tænia cucumerina*, *T. litterata*, *T. marginata*, and *T. echinococcus;* of these four *T. cucumerina*, though by far the most common, may be left out of consideration as its intermediate hosts are, as is well known, canine skin parasites, *Trichodectes canis* and. as has been more lately shown by Sonsino, *Pulex serraticeps.** *Tænia marginata* may also be easily excluded, as the peculiar burrows characteristic of recent in ection by the embryos of that species, and well figured by Curtice,† were entirely absent from the cases under discussion.

Of the intermediate host of *T. litterata*, so far as I know, nothing is known, and as this species is commonly enough found in large masses in the pariah dogs here, there is no particular reason why this species should not be the culprit. It is indeed only the close microscopic resemblance of the embryos to the known embryos of compound echinococcus cysts, that leads me to give preference to the probability of their being referable to the last-mentioned species. One consideration that remains is that, putting aside the hypothetical *T. tenella* of Cobbold, none of the cysticerci proper to sheep belong to species parasitic in the adult stage in man, and hence no possible risk can be involved in the consumption of meat affected in this way.

The nematode tubercles were found exclusively in the livers of mules and horses, and must be tolerably common in Assam as they were observed twice in the half dozen or so examinations made there. Since then I have had no further opportunities of examining equine animals, and so have no knowledge how far they may be common in other parts of India. Close as is their naked eye resemblance to the

* Sonsino, 'Ricerche sugli ematozoi del cane e sul ciclo vitale della *tænia cucumerina*,' Pisa, 1888.

† Curtice, 'Animal Parasites of Sheep,' Washington, 1890, p. 80.

cestode tubercle, they differ markedly when microscopically examined, their perfectly defined outline contrasting strongly with the hazy demarcation of the cestode tubercle. Their vascular origin is fairly well indicated by their position being always interlobular. The immense numbers that may be present may be judged from the fact that four are visible in a single field of Zeiss A, and that they seemed in this case fairly uniformly distributed through the organ.

Two distinct layers are distinguishable in each tubercle: an outer or fibrous layer, which is, I believe, derived from the dilated coat of the vessel which carried the embryo to its destination, and a central portion which, to all appearance, is merely altered blood-clot. In some cases the boundary between the two layers is quite sharp and distinct; but generally, and more especially in the larger tubercles, the transition is less abrupt, the cellular central portion altering gradually into the distinctly fibrous outer layer. Generally at or near the centre, but occasionally a good deal excentric, will be found the nematode embryo, which has originated the whole of the changes described, and which bears so insignificant a proportion to the dimensions of the nodule in which it is contained, that it is easily missed unless the series of sections be quite complete. As a general rule, the embryo is coiled up into so close a knot, that no sign of it will be visible in more than one or two sections. The embryos themselves are in the earliest stage of extraoval life, and appear to possess no other organ than an empty intestinal canal; and even this is so delicate that, after the action of hardening agents, little more remains visible than the cuticular layer of the worm. They are somewhere about three or four times the diameter of a red corpuscle in cross-section, and are proportionately rather short; but owing to the way they are coiled up in the solid tissue of the hardened tubercle it is impossible to form more than a guess as to their absolute length. Nor have I been able to make out anything definite as to the form of either extremity of the worms. In thin sections nothing, as a rule, can be made out, as even with careful fixative arrangements the little worm sections nearly always drop out, or, if retained by the fixative, show merely a structureless ring, from which nothing can be made out. On this account, tolerably thick sections are alone suitable for the study of the general relations of these nematodes.

The tubercles, it is almost needless to say, far exceed the lumen of any interlobular vessel in diameter, so that if the above reading of their origin be correct, a considerable amount of proliferation and dilatation must have taken place.

There is nothing, however, in the structure of the nodules that need negative the idea of their being derived from the occlusion of branches of the hepatic artery instead of from those of the portal system.

The parentage of these embryos must for the present remain a

matter of uncertainty, but, in all probability, they must be the progeny of some hæmatozoon, whose habitat must be either the portal vein or hepatic artery, the absence of a more general infection excluding the idea of an aortic habitat, while most certainly no hæmatozoa were present in the heart in either case. Such being the case, the adult must probably be a filarian, possibily a strongyle.

Although never previously recorded from India, what was doubtless a nematode tuberculosis of the equine liver has been described by G. Colin and Reynal.* Oreste and Ercolani † attributed them to the lodgment of the ova of distomata, their nematode nature being first made out by Mazzanti ‡ in 1890.

As far back as 1876 Sonsino found free nematodes in the blood of horses in Egypt, but such a species, if lodged in the capillaries, could hardly fail to set up a general infection, and not that of a special organ.

A possible parent of the embryos may be found in *Filaria papillosa*, a few individuals of which were found in the peritoneal cavity of each of the animals in which this condition was present. Mazzanti, it is true, specifies that the embryos contained in the nodules he describes were different from those of *F. papillosa*, but, as we are quite ignorant of the complete life-history of that parasite, his specimens for comparison could have hardly been derived from any other source than the body of the adult female, and the embryos would alter so rapidly when encysted in new surroundings, that I doubt if such a comparison affords just grounds for any conclusions whatever.

This worm, it must be remembered, burrows its way into all sorts of odd situations, the eye and brain, e. g., so that there would be nothing extraordinary in its finding its way into the portal vein, hepatic artery, or any other vessel.

Another possible source of infection is *Selerostomum equinum*, whose worm-aneurisms were present in, at any rate, one of the cases in question. I am aware that the inhabitants of these aneurisms are generally considered to be always immature. I have met with some, however, containing tolerably well developed ova, and, though perhaps improbable, it is by no means impossible that they may occasionally reach maturity in this situation. These aneurisms do not always occlude the vessels in whose course they lie, and, as they are not uncommon on the hepatic artery, a female discharging her eggs in this situation would readily bring about an infection exactly similar to that under discussion.

Failing these sources of infection, we are reduced to the assump-

* Reynal, art. Foie, Nouv. dict. prat. de méd., de chir. et d'hyg. vétér., vii. (1862) p. 205.

† *Fide* L. G. Neumann, 'Traité des Maladies Parasitaires non microbiennes des animaux domestiques,' Paris, 1892, p. 487.

‡ Mazzanti, "Contributo all'etiologia dei noduli epatici del cavallo," 'Il Moderno Zooiatro,' i. (1890) p. 145.

tion of a yet unknown hæmatozoon, inhabiting the portal vein or hepatic artery, and allied perhaps to Baillet's *Strongylus vasorum* found in the larger divisions of the pulmonary artery of dogs, and causing a very similar infection of their lungs. One more point in the literature of the subject remains to be noticed, and this is that Mazzanti* speaks of the embryos as having been carried to their destination by a capillary which occupies the centre of the nodule. I have not been able to find any trace of this capillary, the only thing I have met with at all like it within them, being sections of the embryo itself, which occasionally present a deceptive resemblance to those of a small vessel. In conclusion I would wish to point out that the microphotographs illustrating this note are intended to show general relations only, as I have purposely avoided entering into any minute details of the micropathology of the tissues surrounding the parasites described.

* Loc. cit.

VI.—*Note on a Tapeworm from Echidna (Tænia Echidnæ sp. n.).*

By D'Arcy W. Thompson.

(*Read 19th April*, 1893.)

Plate V.

Some few months ago Prof. Jeffrey Bell entrusted me with a small number of Tapeworms from the intestine of *Echidna hystrix*, preserved and brought home by Prof. T. P. Anderson Stuart, of Sydney, N.S.W. So far as I am aware, the cestode parasites of the Monotremata are quite unknown, and the new species is therefore interesting from its habitat, though it shows no very remarkable points of structure. Having been fixed in chromic acid, the worms are very much contracted. The longest specimens measure about 5 cm., and contain, besides the head, about 200 proglottides. The ripest proglottides are about ·7 mm. long; the worm is about 4 mm. broad from side to side, and about 1 mm. dorso-ventrally.

Tænia Echidnæ belongs to the unarmed or hookless section of the genus. The head is exceedingly small, short and low, and is surrounded by a thick, broad ridge or fold, little broader than the neck; viewed from above, the head is oval in outline. The proboscis is a low conical eminence, rising gradually from within the outer boundary ridge. Between the ridge and the eminence of the proboscis are the four suckers, visible in the preserved specimens as so many small slits, within which the suckers are concealed as deep invaginated pouches. The neck is short, broad, and ill-defined, little narrower than the head in front, and reaching within the space of a very few proglottides to the full breadth of the body. The generative apertures open on the margins of the proglottides, in irregular alternation. From three to six open consecutively on the one side, to be succeeded by about as many more opening on the other. The penis is long and smooth, the genital cloaca deep and well developed. In transverse sections the longitudinal nerve-cord, the inner and outer water-vessels, and the commissural water-vessel in the posterior end of each proglottis were easily seen. The small number of available specimens did not warrant a further study of the internal structure, nor did any features of discrepancy from the normal type of the genus appear to render it necessary.

EXPLANATION OF PLATE V.

Fig. 1.—*Tænia Echidnæ* sp. n., nat. size.
„ 2, 3.—The head and anterior portion of the worm. × 6.
„ 4.—The head of another specimen. × 6.
„ 5.—The head, rendered transparent with oil of cloves, to show the suckers. × 20.
„ 6.—A portion of the body of the worm: × position of genital apertures. × 10.
„ 7.—Ditto, in marginal view, showing the exserted penes. × 10.
„ 8.—A transverse section through the genital cloaca, *g. cl.*; *p. sh.*, sheath of the penis; *pr. p.*, protractor penis; *od.*, oviduct; *n. c.*, nerve-cord. × 110.
„ 9.—A transverse section, to show *n. c.*, nerve-cord; *o. w. v.*, outer longitudinal water-vascular canal; *i. w. v.*, inner ditto. × 110.

VII.—*Notices of some undescribed Infusoria from the Brackish Waters of the Eastern United States.*

By Alfred C. Stokes, M.D.

(*Read 15th March*, 1893.)

Plate V.

With a few exceptions, which are mentioned in the proper place, all of the following presumably undescribed Infusoria were observed amongst collections of filamentous Algæ made from the brackish waters about Coney Island, N.Y., by Mr. Henry C. Wells, of New York City, and by him sent to me.

Cothurnia fecunda sp. n. Pl. V. fig 1.

Lorica transparent, about three times as long as wide, compressed so that the anterior border is oval in outline, slightly everted, the margin smooth and even; broadest near the posterior one-third; tapering thence to the somewhat acutely rounded posterior point of attachment, and anteriorly to the frontal aperture; pedicle short, apparently passing through the posterior border of the lorica, longitudinally striate, and penetrating for a short distance into the cavity of the sheath, and there supplying the enclosed animalcule with an inconspicuous foot-stalk; cuticular surface finely and transversely striate. Length of lorica 1/225 in. Hab.—The brackish water of the Morris and Essex Canal, near Greenville, N.J.; attached to filamentous algæ. Social.

This characteristic form is prolific and social, being often found in colonies on filamentous algæ and on other small submerged objects, and frequently with two full-grown animalcules in the same lorica, the two so crowding each other that but one is capable of an incomplete retraction into the sheath, the other simply folding its ciliary apparatus and making an ineffectual and spasmodic effort to retract itself into the cavity of the common sheath. The gathering amongst which it was found was made in the locality mentioned, and sent to me by Mr. Stephen Helm, of New York City.

EXPLANATION OF PLATE V.

Fig. 1.—*Cothurnia fecunda*, × 200.
„ 2.—*Cothurnia inflata*, × 344.
„ 3.—*Cothurniopsis valvata*, × 400. Lateral aspect.
„ 4. „ „ „ Front view.
„ 5.—*Tintinnus tubus*, × 325.
„ 6.—*Metacystis striatus*, × 312.
„ 7.—*Lagynus ornatus*, × 180.
„ 8.—*Litosolenus armatus*, × 210.
„ 9. „ *verrucosus*, × 200.

Cothurnia inflata sp. n. Pl. V. fig. 2.

Lorica urceolate, not gibbous, twice as long as broad, widest and inflated posteriorly, the posterior border rounded; the lateral margins often undulate; the anterior, neck-like prolongation cylindrical, somewhat curved toward one side, the frontal border truncate, the aperture oblique; pedicle short; enclosed animalcule elongate, finely striate transversely, and attached posteriorly through the intermedium of a short, longitudinally striate, internal secondary pedicle; ciliary disc obliquely elevated; peristome with a collar-like membrane, highest and most conspicuous on the oral side; contractile vesicle single, spherical, situated in the anterior body-half in close proximity to the pharyngeal passage, and often forced out of shape by the pressure of the increasing food-mass; nucleus apparently long, narrow, band-like, extending near one lateral border and through nearly the entire length of the body. Length of lorica 1/430 in. Hab.—Brackish water near Longport, Long Island, N.Y. Collected by Mr. R. O. Bogert.

This form somewhat resembles *C. curva* Stein, varying from that species, however, in the much shorter pedicle of both lorica and animalcule, in the more anterior position of the contractile vesicle, in the much greater proportionate length to which the extended body is protruded beyond the aperture of the lorica, in the transverse cuticular striations, in the elongated nucleus, and especially in the evenly rounded, non-gibbous form of the lorica.

Cothurniopsis (*Cothurnia*; ὄψις, *form*) g. n.

Lorica erect, posteriorly pedicellate, the anterior lateral border a movable valve-like continuation of the lorica wall and closing the anterior aperture when the enclosed infusorian is contracted; animalcule otherwise as in *Cothurnia*.

Cothurniopsis valvata sp. n. Pl. V. figs. 3, 4.

Lorica corneous, elongate-ovate or broadly urceolate, about twice as long as broad, widest and inflated posteriorly, but differing in appearance according as the frontal or the lateral aspect is observed; in lateral view elongate-ovate, the posterior border rounded, the anterior region narrowed, compressed and neck-like, the frontal border obliquely truncate, this portion forming the valve-like appendage closing the anterior aperture when the animalcule is retracted; in frontal aspect broadly urceolate, the posterior border rounded, centrally thickened into a short, boss-like truncate projection, through which passes a longitudinally striate continuation of the pedicle; anterior region forming a broad, neck-like portion, the frontal border convex, the valve-like appendage being invisible in this position; pedicle conspicuously developed; enclosed animalcule projecting, when extended, for about one-third of its entire length beyond the lorica; cuticular surface transversely striated; an anterior collar-like mem-

brane apparently not present; contractile vesicle single, spherical, anteriorly located; nucleus not observed. Length of lorica, 1/450 in. Hab.—Brackish water about Coney Island, N.Y.

Tintinnus tubus sp. n. Pl. V. fig. 5.

Lorica subcylindrical, chitinous, colourless and hyaline, less than five times as long as broad, tapering posteriorly, both extremities truncate and both open; enclosed animalcule ovate, the temporarily developed posterior pedicle often exceeding the body in length, and adherent to one lateral border of the lorica; frontal cilia large, and apparently finely fimbriated; cuticular cilia fine and short; peristome excavate, bearing at its central and deepest region an elevated, tongue-like projection, usually in continuous motion when the body is expanded. Length of lorica from 1/200 to 1/300 in. Hab.—Brackish water from a salt marsh on Coney Island, N.Y.

That the lorica is open at both extremities has not been previously recorded for any other of the numerous species of the genus, but here the openings are conspicuously demonstrated by the continuous trembling and by the to-and-fro movements of the expanded animalcule; the currents thus produced in the water carry with them bacteria and other minute particles into and out of the posterior aperture of the lorica.

Metacystis striata sp. n. Pl. V. fig. 6.

Body subcylindrical, often somewhat curved laterally, the anterior extremity slightly narrowed, but abruptly truncate; posterior vesicle-like region hyaline, colourless, and often rather more than a hemisphere in form; oral aperture apparently followed by a short membranous pharyngeal passage; cuticular surface finely striate longitudinally, and ornamented by transversely encircling parallel series of minute bead-like projections; cilia fine and numerous, apparently arising from the cuticular surface in close proximity to the bead-like elevations; nucleus subspherical, located near the centre of the body and near the single contractile vesicle. Length from 1/240 to 1/230 in. Hab. —Brackish water among decaying algæ.

Movements exceedingly rapid, and rotary on the longitudinal axis, with long intervals of rest in one locality, when the infusorian, almost periodically, suddenly retreats backward for a distance about equal to its length, and at once returns to its former position with one or more revolutions on the longitudinal axis. When the animalcule is in a quiescent condition the oral cilia are unfolded across the anterior truncated region.

From *Metacystis truncata* Cohn it differs widely in size and in the absence of the transverse annulations. Collected by Mr. R. O. Bogert, at Northport, Long Island, N.Y.

Lagynus ornatus sp. n. Pl. V. fig. 7.

Body elongate, flask-shaped, somewhat depressed, elastic, about five times as long as broad when extended; anterior margin truncate,

the region immediately posterior to the frontal border somewhat dilated; cuticular surface ornamented by minute, hemispherical, bead-like elevations arranged in longitudinal parallel series; contractile vesicle single, spherical, in close proximity to the posterior extremity, occasionally produced by the coalescing of several small spherical vacuoles; nucleus apparently subcentrally located, large, subspherical; oral aperture exceedingly expansile; frontal cilia each of two distinct parts, a thickened basal portion and a longer, finer, filamentous flagellum. Length of body from 1/120 to 1/160 in. The body is occasionally extended until the lateral borders are almost parallel and the infusorian elongated and band-like in appearance. Hab.— Brackish water from near Northport, Long Island, N.Y. Collected by Mr. R. O. Bogert.

Lembus striatus Fabre-Domergue.

It is exceedingly interesting to find this infusorian, as I have found it, amongst the algæ decaying in the brackish waters from about Coney Island, N.Y. Dr. Fabre-Domergue not long ago discovered it in the Atlantic near the Laboratory of Marine Zoology at Concarneau. Reproduction, as I have observed, is by transverse fission.

Litosolenus (λιτὸς, *smooth*; σωλὴν, *a channel*) g. n.

Animalcules free-swimming, hypotrichous, soft, flexible, and elastic; body elongate-ovate, depressed, the ventral surface flat, entirely and finely ciliated; the dorsal region elevated, smooth, and convex; the entire body-margin elevated so that the anterior, the posterior, and the lateral regions of the ventral aspect are convex, and the corresponding portions of the dorsal surface conspicuously hollowed, the elevated sub-central dorsum being thus surrounded by a shallow, smooth, trench-like groove extending about the entire peripheral portion of the body; anterior region not prolonged into a neck-like continuation, as in *Litonotus*; trichocysts numerous.

Litosolenus armatus sp. n. Pl. V. fig. 8.

Body elongate-ovate, about twice as long as broad, widest near the posterior extremity, thence tapering gradually to the obtusely pointed, often somewhat oblique anterior border; subcircular in outline, and dorsally rounded when completely contracted; left-hand lateral border convex; the right-hand margin somewhat flattened, occasionally slightly concave; posterior border convex; upper surface of the elevated dorsal region gradually sloping from near its central portion toward the anterior extremity, where it becomes merged into the general aspect of the body; the entire dorsal surface finely and longitudinally striate; the encircling groove-like region marked by striæ parallel with the body-margins; cilia of the ventral region fine and short; the entire circumferential border of the infusorian armed by numerous, equidistant, colourless, curved and acuminate hook-like processes, varying in number and in size in different individual

animalcules; nuclei four in number, the nodules broadly ovate or subspherical, in close proximity to one another and apparently connected by a short funiculus; contractile vesicles spherical, two or three in number, one usually in the anterior body-half, another in the posterior body-region, often with a third developed between them; endoplasm colourless, usually granular; trichocysts numerous, arranged at right angles to the body-margin. Length of body, from 1/150 to 1/200 in. Hab.—Brackish water from near Northport, Long Island, N.Y. Conjugation lateral. Collected by Mr. R. O. Bogert.

The dorsal region proper seems to be much softer and more completely under the control of the animalcule than the other regions of the body. It is often seen to be variously indented, or irregularly hollowed; it may also at times be actually observed to undergo these alterations of form, whilst occasionally the entire mass of the elevated region may be seen to sway toward one side, as if its consistency were unusually slight. Yet the surface of the dorsal aspect bears several fine, hispid setæ.

In some individual animalcules the body-margin is so greatly upturned that the hook-like processes are directed inward, that is, toward the median line of the body, thus becoming very inconspicuous. In these instances the hooks have seemed to be unusually small and numerous.

Another form, sent to me from Coney Island, N.Y., by Mr. H. C. Wells, differs from that referred to in the foregoing description in that the hook-like appendages are exceedingly small, fine and inconspicuous, so that they must be searched for carefully to be distinguished amongst the rapidly moving cilia, whereas in the commoner forms the hooks are prominent.

Litosolenus verrucosus sp. n. Pl. V. fig. 9.

Body elongate-ovate, very soft and flexible, and somewhat changeable in shape, the right-hand body-margin often slightly flattened; widest posteriorly, the frontal extremity usually obtusely pointed, occasionally the right-hand border obliquely truncate; ventral surface convex, the lateral borders so much elevated that the body is almost boat-shaped, the dorsal margins of this elevated region bearing a varying number of rounded papilliform elevations, each with one or more fine setæ, and often with several additional hispid setæ; the space between the papillæ usually concave; dorsal region but slightly elevated, usually scarcely projecting above the level of the upturned lateral body-margin; nuclei four in number, subspherical, located subcentrally near the left-hand body-margin; contractile vesicles multiple, arranged near the right-hand border; cuticular surface finely and longitudinally striate; trichocysts abundant, chiefly clustered in a fascicle within each papilliform elevation. Length of body about 1/120 in. Hab.—Brackish water, from a marsh on Coney Island, N.Y.

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.†

Germinal Layers in Vertebrates.‡—Herr B. Lwoff distinguishes in the development of *Amphioxus* between the palingenetic invagination which forms the archenteron and the cenogenetic dorsal invagination of ectoderm which forms (he says) the rudiment of notochord and of mesoderm. In all cases these two processes can be distinguished. In no Vertebrate is the gut formed by invagination. The endoderm cells are grown round by the ectoderm, and the gut arises by a cleavage in the endoderm. All attempts to find dorsal and ventral gastrula-lips are far-fetched. Of one area, however, we may be sure, namely, that where the "ectoblastogenic" rudiment of notochord and mesoderm is formed. The neurenteric canal should be called a neurochordal canal, for that is what it is. The common origin of the nervous system and the rudiment of the notochord and mesoderm suggests affinity with Annelids in which there is a common neuromuscular rudiment. Herr Lwoff's most important contentions are (1) that the notochord and associated musculature have an ectodermic not endodermic origin, and (2) that with their rudiment that of the nervous system is associated. He promises to demonstrate this in detail; the task, we should think, will not be an easy one.

Development of Mammary Glands.§—Prof. O. Schultze finds in embryos of pig, rabbit, mole, fox, and cat, that the first rudiment of the

* 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.

‡ Biol. Centralbl., xiii. (1893) pp. 76–81.

§ Verh. Physik.-Med. Gesell. Würzburg, xxvi. (1893) pp. 171–82 (2 pls.).

mammary glands is seen as a linear epithelial thickening on each side of the body—a thickening strangely suggestive of the epithelial rudiment of the lateral branch of the vagus-nerve in aquatic Vertebrate embryos. This "milk-line" stretches from the anterior to the posterior limb-rudiment, and at intervals there are swellings which generally correspond in number to the mammæ which are afterwards developed.

The Shell of a Hen's Egg.*—Herr W. v. Nathusius has made some new observations on this familiar but puzzling structure. He is firm in his previously expressed conviction that the egg-envelopes must be regarded as "a growing organism." Even the superficial external membrane is represented in the immature ovum. The rudiments are ovarian, the growth is by intussusception; the theory of mechanical apposition of oviducal secretions is false.

Cellular Islets at the Margin of the Blastoderm of the Chick.† Dr. O. van der Stricht notes the exceptional occurrence of cellular islets in the vitellus beneath the ectoderm. From the first they are formed of distinct cells, and not of a protoplasmic mass with multiple nuclei. Several, if not all of them, owe their origin to a budding of ectoderm cells. The author cannot regard them as rudimentary vascular islets, which was Vialleton's interpretation of these or somewhat similar structures; but their import remains unknown.

Development of the Vertebral Column.‡—Herr C. Hasse thinks that the ancestral Craniota must have had a cuticula chordæ formed from the notochord and a cuticula sceleti formed from the skeletogenous layer. The Cyclostomata seem, as regards vertebral column, to be nearest the primitive form, and the "Tectobranchii" (viz. Ganoids, Teleosteans, Anura, Amniota) retain a more primitive condition than the "Elasmobranchii" (viz. Elasmobranchs in the ordinary sense, Dipnoi, and Urodela). The former have at first a cuticula sceleti directly exterior to the cuticula chordæ; the latter have between the two cuticulæ an intercuticular layer. We hardly think that Herr Hasse is warranted in his new use of the term Elasmobranch.

Development of Liver and Pancreas in Trout.§—Dr. Ph. Stöhr finds that in Teleosteans, as also in Amphibians, Birds, and Mammals, the pancreas has a threefold rudiment. Even before the closure of the gut there appears a dorsal solid knob—the dorsal part of the pancreas; subsequently, on each side of the opening of the duct of the liver, there appears a short cylindrical body. Each of these is a pancreas-rudiment. The duct of the dorsal rudiment disappears; the dorsal rudiment unites with the rudiment which lies ventrally to the right; the left rudiment remains small; the two ventral ducts unite and open into the gut independently of and behind the duct of the liver.

Duration of Motion of Human Spermatozoa.‖—Mr. G. A. Piersoll cites various authorities who state that the spermatozoa may continue to move during 24–84 hours after death, in the fluids of the seminal tract. Outside the body, movement has been observed by Hofmann after

* Zeitschr. f. wiss. Zool., lv. (1893) pp. 576–84 (4 figs.).
† Anat. Anzeig., viii. (1893) pp. 266–71 (5 figs.).
‡ Tom. cit., pp. 288–9. § Tom. cit., pp. 295–8. ‖ Tom. cit., pp. 299–301.

72 hours; and Mantegazza states that he kept human spermatozoa at 0° C. for 4 days without their losing their vibratile powers. Mr. Piersoll kept preparations at a temperature of 7–8° C. for as long as 8 days 10 hours, after which some of the elements displayed feeble movements at a temperature of 25° C. In another preparation, kept for 9 days 9 hours at a temperature of 8·5° C., a few of the elements exhibited well-marked motion after being placed in 25° C. for an hour. The capability of moving was more persistent in those cases in which vibration was temporarily arrested from time to time by reduced temperature, for in control preparations kept continuously at 21° C. the motion continued to the end of the fourth day and then stopped. These facts suggest that the male elements may long retain their vitality in the female generative tract; and they are also of interest in connection with certain medico-legal questions.

Development of Amphioxus.*—Herr B. Lwoff finds that his results do not in all respects tally with those of Hatschek. According to Hatschek, the longitudinal axis of the gastrula crosses that of the blastula at a sharp angle, and the asymmetry is partly explained by the activity of the endoderm as contrasted with the ectoderm. According to Lwoff there is no cessation of division on the part of the ectoderm, mitoses being most frequent in the future dorsal surface of the gastrula and at the margin of invagination. At the margin of invagination the single-layered nature of the epithelium is lost. In short, the invagination is due to the continuance of the more rapid—especially dorsal—multiplication of micromeres, which are invaginated dorsally, forcing the proper endoderm cells to lie on the floor and sides of the cavity. This dorsal invagination of ectoderm is a cenogenetic process which has to do not with gastrulation, but with the formation of the notochord and mesoderm. In Amniota the palingenetic gastrulation proper becomes subordinate; the cenogenetic "ectoblastogenic invagination" becomes more prominent. As to the pole-cells which Hatschek believes to form the posterior mesoderm, Lwoff cannot after careful searching find them. The formation of the mesoderm folds is not an active invagination, but is due to the sinking down of the medullary plate. Lwoff will not admit that they are simply diverticula of the archenteric wall, nor even that their cavities form the body-cavity. For (1) the dorsal wall of the archenteron is not like the ventral wall, as above explained, and (2) the cavities of the fold disappear in each primitive segment, subsequent divergence of cells forming the true cavities. In short, *Amphioxus* is, after all, *not* an example of enteroccelic formation of a cœlom. The notochord arises from the "ectoblastogenic" rudiment, though endoderm cells perhaps help. The connection of notochord and endoderm is at least secondary. Herr Lwoff promises further details in support and extension of his somewhat upsetting conclusions.

Inheritance of Modifications.†—Mr. J. A. Ryder treats of the inheritance of modifications due to disturbances of the early stages of development, especially in the Japanese domesticated races of Gold-Carp. The evidence now before him compels him to withdraw his previously-

* Biol. Centralbl., xii. (1892) pp. 729-44.
† Proc. Acad. Philadelphia, 1893, pp. 75-94.

made suggestion that the double-tailed races of Gold-Carp owe the doubling of the anal and caudal fins to a remote ancestral condition in fishes, in which paired lateral fin-folds extended for the whole length of the body. As many of the conditions are perfectly parallel to those seen in traumatically deformed trout the author thinks that it is almost conclusively proven that the double-tailed races of Gold-Carp have arisen in the first place as a consequence of injuries inflicted during the early development of the eggs and embryos, and that the effects of these embryonic traumatisms have become hereditarily transmissible.

Inheritance of Mutilations.*—Dr. O. vom Rath criticizes some cases of apparent transmission of mutilations. There was a pair of terriers, descended from normal parents, and producing normal offspring. By an accident the upper portion of the right humerus of the male was broken, and the result was a permanent injury. Some time after convalescence there was a litter—a female and two male offspring; the female was quite normal, but died, and the mother also came to its end; one of the male offspring was the picture of its mother; the other had an abnormally placed right fore-limb and a limp! In certain details, however, which we need not give, the lameness of the offspring was different from that of the parent. Dr. vom Rath points out in an unbiassed manner the possible interpretations, which must be obvious to those who have followed recent discussions.

Herr S., a normal, well-proportioned man, was wont from his youth to put the point of his right foot further outwards than the left; his three sons directed the points of both feet outwards in a similar manner. Now the father of Herr S. had, when a young man, an accident which led to an outward pointing of his left foot. But inquiry showed that Herr S. junior was several years of age when his father met with his accident; moreover, Herr S. senior had always had a weakness in his right leg. Comment is unnecessary. A third very interesting case is described in which a duel-mark *seemed* to be transmitted through two generations. The author sums up cautiously against the likelihood of somatogenic characters being transmitted.

The Germ-Plasm.†—Prof. A. Weismann has in his recently published volume worked out his theory of heredity, which centres around his conception of the germ-plasm. This germ-plasm is a nuclear substance which contains reserve vital units or biophors for the construction of the corresponding cell-body, as well as for the formation of all the cell-bodies of the entire organism. All these biophors are connected together into a definitely arranged structure in such a manner that the constituent parts share regularly and successively, and not simultaneously, in the control of the cell-body. In order that this result may be produced, the biophors are combined to form units of a higher order—the determinants, each of which controls *one* kind of cell, and consequently includes all the biophors required for the determination of this particular kind of cell. The germ-cell contains at least as many determinants as there are different cells or groups of cells in the fully formed organism

* Biol. Centralbl., xiii. (1893) pp. 65-76.

† 'The Germ Plasm: A Theory of Heredity,' translated by W. Newton Parker and Harriet Rönnfeldt, London, 1893, 8vo, xxii. and 447 pp., 24 figs.

which are capable of being individually determined from the germ onwards. The determinants have a definite mutual arrangement in the germ-plasm, forming aggregates of a higher order, the "ids." It is probable that parts of the "chromosomes" are the "ids," and that the nuclear rods are aggregates of "ids," which are spoken of as "idants." After a discussion of the germ-plasm, the author considers regeneration, multiplication by fission and gemmation, alternation of generations, the formation of germ-cells, amphimixis, reversion, dimorphism and polymorphism, the transmission of acquired characters and variation. Whatever may be the opinion of biologists as to Weismann's conclusions, it will be allowed by all that the book is rich in accumulated learning, ingenious argument, and bold speculation.

In a short note * Prof. Weismann discusses the share which Jäger, Nussbaum, and others have had in developing the modern conception of heredity.

Reproduction and Heredity.†—Dr. M. Nussbaum was one of those who several years ago (1880) directed attention to the organic continuity between generations—an idea which Weismann has done much to confirm and elaborate. What Nussbaum expounded, however, was a continuity of germ-cells, not of germ-plasm. To this he adheres, and in defending his own position criticizes Weismann's recent book. He has also something to say as to the share which he, Jäger, Weismann, and others have had in the historical development of our present conception of heredity.

β. Histology.

Cell-division.‡—Prof. E. Strasburger reviews the present state of our knowledge of cell-division. Between animal and vegetable histology there is mutual influence, as has been illustrated lately in regard to attraction-spheres. For these the author proposes the more morphological term "astrosphere." The cytoplasmic origin of the nuclear spindle—independent of the proper nuclear substance—is discussed. The division of the pollen-mother-cell in a lily is sketched. Strasburger is inclined to regard the movement of the nuclear segments as active, under the influence of a chemotactic stimulus from the centrospheres. The substance which forms the spindle-fibres, and which in plants is cytoplasmic, not nuclear, Strasburger calls kinoplasm. It seems to be the same as Boveri's archoplasm. Various recent researches are summarized in this paper.

Imitation of Karyokinetic Figures.—Prof. O. Bütschli § has been able to mimic centrosomata and attraction spheres in gelatin-oil foams. The contraction of a central air-bubble produces surrounding radiations. Dr. H. Henking ‖ has got similar appearances by letting drops of alcoholic solution of shellac or some other fluid fall on a smoked surface of paper or glass. In this case the radiations are due to expansion, not to contraction. Some photographs of the imitations are appended, so

* Ber. Nat. Gesell. Freiburg, vii. (1893) pp. 36–7.
† Arch. f. Mikr. Anat., xli. (1893) pp. 119–45.
‡ Anat. Anzeig., viii. (1893) pp. 177–91.
§ Verh. Nat. Med. Ver. Heidelberg, v. (1892).
‖ Arch. f. Mikr. Anat., xli. (1893) pp. 28–39 (1 pl.).

that the reader may judge for himself of their resemblance to nuclear figures.

Structure of Nerve-Cells and their Processes.*—Prof. A. S. Dogiel has continued his investigations on this subject, with especial reference to the retina. The nerve-cells of the retina are of three types:—(*a*) cells with protoplasmic processes and an isolated axis-cylinder process which passes directly into the axis-cylinder of the nerve-fibre; (*b*) cells with protoplasmic processes and one axis-cylinder process, which breaks up into fine branches and threads; (*c*) cells with only protoplasmic processes. An axis-cylinder of a nerve-fibre begins (1) directly from a cell or from one of its protoplasmic processes, or (2) from the network of the second type of nerve-cell (*b*), or (3) directly from the branches and threads of the protoplasmic processes of the third type of cell (*c*). The protoplasmic processes of the nerve-cells of the retina unite in a network connecting the cells of one type. Like the axis-cylinder processes the protoplasmic processes have a nervous character. The cells and their processes have fibrils and interfibrillar substance, and some of the fibrils of all the protoplasmic processes of a cell pass into the axis-cylinder. To the nerve-cells belong higher nervous and probably trophic functions. The nerves cannot be considered as isolated elements.

Giant-cells of the Medulla and their Central Corpuscles.†—Herr M. Heidenhain finds in the resting giant-cells of the red osseous medulla in the rabbit *numerous* central corpuscles, in many cases over 100 in one cell. In one very large pluripolar mitotic figure there were 135! So many form a main group in the endoplasm, while others form one or several accessory groups in the first zone of the exoplasm. For further notice we await the promised publication of figures and full details.

Weil's Basal Layer of Odontoblasts.‡—Dr. C. Röse devotes a considerable amount of space to a demonstration of the non-existence of this layer except as an artificial product.

Contractile and Conducting Primitive Fibrils.§—Prof. St. Apáthy believes that the primitive fibrils of smooth muscle and of nerve have been hitherto overlooked; the interfibrillar spaces have been seen, not the fibrils. By Apáthy's gold method, the details of which are not given, the fibrils may be seen dark violet against the pale red interfibrillar substance. The fibrils are not stained with the usual anilin dyes.

Apáthy finds that a smooth muscle-fibre (of Hirudinea) shows clear and dark bands. The essential difference between the two kinds of fibre is that in the smooth fibre the elementary fibrils are straight and parallel to the longitudinal axis, while in the striped muscle they run in undulating lines. Haycraft's varicosities the author believes to have been artificially produced.

When the optical characters of myelin predominate in a nerve, the

* Arch. f. Mikr. Anat, xli. (1893) pp. 62–87 (2 pls.).
† SB. Physik.-Med. Gesell. Würzburg, 1892. pp. 30–3.
‡ Anat. Anzeig., viii. (1893) pp. 272–85 (5 figs.).
§ MT. Zool. Stat. Neap., x. (1892) pp. 355–75 (1 pl.).

nerve is negatively refractive; when those of the conducting primitive fibrils predominate, the nerve is positively refractive—facts which explain Ambronn's observations as to the change of optical characters.

Nerve-cell and ganglion-cell are histologically and physiologically diverse; both have arisen phylogenetically from neuro-ganglion cells, which originally are modified sensory epithelial cells. The nerve-cell finds its analogue in the muscle-cell. Both are made up of spindles, i. e. of elements which are cells or have arisen from endogenously divided embryonic cells. A nerve-fibre is either a fused row of nerve-spindles or is one nerve-spindle. Of muscle- and nerve-spindles there are two types, the massive bundle-like and the hollow tube-like, but both types are often combined. The contractile substance and the conducting substance are alike intracellular plasmic products, and consist of primitive fibrils and of intrafibrillar substance. Each primitive fibril consists of one or of several elementary fibrils. The author illustrates his conclusions with especial reference to the Hirudinea.

Structural Resemblance between Emulsions and Protoplasm.*—Prof. O. Bütschli has been able to make, as we have previously reported, extremely fine foams which, to a certain extent, resemble protoplasm in structure and even in behaviour. His observations on Protozoa and his experiments with foams lead him to the conclusion that the cytoplasm and the nucleoplasm have a foam-like structure, and consist of a honeycomb-like arrangement of lamellæ with fluid or enchylema in the interspaces.

The most successful emulsions were made from olive oil, which must be heated for 12 days at 50°–60° C., or for a shorter time at a higher temperature. This is mixed with finely powdered non-anhydrous carbonate of potassium. Eventually a fine soap emulsion is formed, which consists of droplets of soap solution surrounded by films of oil. A drop of this is put in pure water and examined. Bütschli's microphotographs show well the intricacy of structure in the froth, the general appearance being that of a complex network. Opinions will differ as to the degree of resemblance between the emulsion structure and that of the cell, but when microphotographs of the two are seen side by side a striking resemblance cannot be denied.

In water the drops of emulsion increase in volume; in glycerin they decrease; they are permeable by methyl-green; and the lamellæ of oil are stainable. Appearances of fibrillation and reticulation, of nodal thickenings and striated borders, and even of the radiations associated with karyokinesis † are observable. In glycerin the structure may be retained for four to six weeks. In various conditions remarkable streaming movements occur. Thus if the drops be resting in a weak solution of potassium carbonate, under a cover-glass supported on wax feet, and if pure water be drawn in, the drops exhibit active movements closely comparable to those of Amœbæ and capable of persisting for hours or even days. These movements depend on surface tensions. It is maintained that analogous, but more complicated, changes of tensions have to do with the movements of amœboid cells.

* 'Untersuchungen über mikroskopische Schäume und das Protoplasma,' Leipzig, 1892, 8vo, 234 pp., 6 pls., 23 figs.

† Sep. Abd. Verh. Nat. Med. Ver. Heidelberg, v. (1892) 14 pp., 2 figs.

Apart from an account of his own experiments, Bütschli gives an historical and critical account of the various interpretations of protoplasmic structure, e. g. those of Flemming, Schneider, Altmann, Fayod, and Künstler, and of protoplasmic movement, e. g. those of Hofmeister, Engelmann, Leydig, Berthold, and Quincke. The author's general conclusion is that protoplasm has a frothy or foam-like structure, and that the physical conditions observable in the bubbles of the artificial foams do *mutatis mutandis* help us towards an understanding of the streaming movements and changes of shape in protoplasmic units. It need hardly be said that Bütschli does not claim to have made "artificial protoplasm." His work has rather been to demonstrate analogies of structure and activity between living and not-living matter; and while it may remain a matter of opinion whether he has really brought us nearer an understanding of a vital movement, it will at least be conceded that the task of eliminating all that can be at present physically explained is useful, and that his work, with its carefulness of observation and ingenuity of experiment, is full of suggestiveness.

γ. General.

Movement of Living Matter.*—Dr. Max Verworn thinks that the problem of vital movement is to be studied most successfully in Rhizopods. To begin with striped muscle is to begin at the wrong end. All the theories of Hofmeister, Engelmann, Hermann, and others are partial at best. Verworn begins with the formation of pseudopodia, as seen for instance in *Orbitolites complanatus*. In an active protrusion the plasmic streaming is wholly centrifugal; when protrusion ceases a centripetal back-flow sets in; in retraction this is the only movement. Cut an outflowing process, the stimulated protoplasm begins to stream centripetally, and, both as a whole and in its parts, tends to form spheres. Cut a piece off altogether; for a time it may give forth pseudopodia, but soon it begins to degenerate, and the phenomena of degeneration are identical with those of an individual persistently stimulated to retraction.

The movement is either an expansion or a contraction. In the phase of expansion there are local lessenings of the surface tension. But what is the condition of a diminution of the surface tension before the expansion of the plasmic sphere? The chemical affinity of the protoplasm for oxygen is the condition. As Kühne showed long ago, the exclusion of oxygen inhibits the protrusion of pseudopodia. It comes to this, that the plasmic particles are drawn within the operative sphere of the oxygen molecules in the medium, and being satisfied remain indifferent, or are shoved aside by their successors. This may be called, if we please, chemotropism. The fact that the unit organism is not or may not be homogeneous, explains why pseudopodia are protruded here and there, and not over the whole surface. So much for expansion. Contraction, on the other hand, is an expression of increased surface tension. This occurs when the satisfied plasmic particles, forming highly complex explosible combinations, break up on being stimulated. This involves profound chemical changes, and the stimulated disrupted particles are drawn to the centre of the unit mass. The condition of the now

* 'Die Bewegung der lebendigen Substanz. Eine vergleichend-physiologische Untersuchung der Kontraktionserscheinungen,' Jena, 1892, 8vo.

increased surface tension is internal; it is due to the nuclear substance, for which the exhausted protoplasm now exhibits chemotropism. A fragment without a nucleus will flow into one which has intact nuclear material.

Fibrillar structure, e. g. of muscle, is a differentiation which secures a motor effect in a definite direction. Here the conditions of surface-tension are obviously more complex than in the Rhizopod; moreover, the muscle has a definite tissue environment. Yet in regard to the stalk of Vorticellidæ the author finds it possible, with no little ingenuity, to make his theory hold good. Into a record of Verworn's still more ingenious interpretation of the contraction of striped muscle we refrain from entering.

The Living Organism.*—Sig. F. Ardissone has published a corrected edition of his essay on the living organism, its essence and origin. As previously noticed, the essay chiefly deals with familiar philosophical questions, such as those of materialism.

Plankton.†—Prof. E. Haeckel gives an analysis of a Plankton collection from the Atlantic, Indian, and S. Pacific oceans. The method of analysis consisted in estimating the components in tenths and percentages of volume. The results are discussed under four heads:—"monotones, prævalentes, polymiktes, and pantomiktes plankton." In the first, at least nine-tenths of the volume consists of similar or identical forms, e. g. Copepods, or Radiolaria. In the second, at least a half consists of similar or identical forms; in the third, no one kind of animal forms over 49 per cent. of the volume; in the fourth, there is a heterogeneous mixture, each sample being a miniature of the general plankton-composition.

Biological Nomenclature. — The American Association for the Advancement of Science has issued a circular containing the recommendations of a special committee, which were unanimously adopted at the Rochester meeting. They think it is necessary to arrive at some agreement as to the underlying principles that should govern Biological Terminology. In an "authoritative glossary" the Latin form should be given as the major heading, and the more common vernacular forms should also be given. They strongly recommend the use of mononyms as against descriptive phrases, etymological correctness, and the formation of paronyms—e. g. Biology is the English paronym of Biologia.

B. INVERTEBRATA.

Influence of Light on Development of Animals.‡—M. E. Yung finds an exception to the rule that green light is unfavourable to the development of animals; this is afforded by some symbiotic forms, the green Planarians, and the green Hydræ, for the former do not do better with violet than green light, and the latter grow more quickly in red than white light.

* 'L'Organismo vivente considerato nella sua essenza e nella sua origine,' 2nd ed., Varese, 1893, 25 pp.

† Jenaische Zeitschr. f. Naturwiss., xxvii. (1893) pp. 559–66.

‡ Comptes Rendus, cxv. (1892) pp. 620–1.

Mollusca.

γ. Gastropoda.

Physiology of Pulmonata.*—M. L. Cuénot finds that there are, in the Pulmonata, five kinds of excretory cells or organs; the kidney; the vacuolar and the cyanophilous cells of the liver; part of the epithelium of the excretory canal of the pedal gland (Limacidæ); and the cells of Leydig, which are physiologically similar to the pericardiac glands of Lamellibranchs, and the branchial heart of Cephalopods. The first three have an acid reaction. The products of digestion are all absorbed through the glandular epithelium of the liver. This liver, in Pulmonates, as in Vertebrates, has the power of stopping all hurtful substances, which become fixed in the epithelium, and of which no trace passes into the cœlom.

There are two kinds of phagocytes in the Pulmonata; the cells of Leydig absorb and digest the foods, which are of an albuminoid nature, while the amœbocytes absorb all strange bodies of whatever kind; the albuminoids are alone digested (in an acid medium), while the other substances remain in the connective tissue.

The cells of Leydig in terrestrial Pulmonates have three functions which are performed by one and the same element; the formation and storage of glycogen, excretion, and phagocytosis. The same cells in aquatic forms divide the duties, for some are only reserve-cells, while others are excretory and phagocytic.

The blue blood of Pulmonates can only absorb an insignificant quantity of oxygen, and the albuminoid contained in it (hæmocyanin) has not a respiratory function comparable to that of hæmoglobin. The amœbocytes of the blood can be reproduced by the direct division of pre-existing elements. In the connective tissue there are mucoid cells identical with those of Vertebrates. The author is of opinion that the calcareous nodules of the connective tissue of aquatic Pulmonates take no part in the formation of the shell.

Pulmonata of Portugal and the Azores.†—Dr. H. Simroth begins his memoir with a chapter on Palæarctic Pulmonata rapacia, describing *Plutonia* (*Viquesnelia*) *atlantica*, *Testacella* Cuv., *Daudebardia*, Glandinidæ, and *Trigonochlamys imitatrix* Böttg. He arranges them according to their affinities as follows:—I. Glandinidæ (the more primitive genera now in Central America); II. Vitrinoidea (*Plutonia atlantica*, native of and restricted to the Azores, *Vitrina pelagica*); III. Hyalinoidea or Testacellidea (more developed from east to west; *Daudebardia*, *Testacella*, *Hyalina*); IV. Limacoidea or Trigonochlamydina (*Pseudomilax*, *Trigonochlamys*, *Selenochlamys*).

Proceeding to the Limacidæ, Simroth describes *Limax maximus* L., *L. variegatus* Drap., *L. arborum* Bouch., *Agriolimax agrestis* L., *A. lumbricoides* Morelet, *A. immaculatus* sp. n., &c.; *Amalia gagates* Drap. A sketch of the relations and distribution of the Limacidæ is then given. A third chapter is devoted to *Parmacella*, a fourth to the Arionidæ, species of *Arion*, *Geomalacus* (*G. Oliveiræ* sp. n.), *Letourneuria*, *Prophysaon*, *Ariolimax*, *Philomycus*. The memoir closes with a discussion

* Arch. de Biol., xiv. (1892) pp. 683–740 (1 pl.).

† Nova Acta K. Leop.-Car. Akad. Halle, lvi. (1891) pp. 200–423 (10 pls.).

of the geological age, geographical distribution, hypsometric relations, and colouring of the Pulmonates, and with a distributional list of the western species.

Development of Bythinia.*—Dr. R. v. Erlanger has followed the development of *Bythinia tentaculata*, and found that it does not differ essentially from that of *Paludina* previously described by himself. The segmentation is the same as that of almost all the other Gastropoda which have been carefully studied, e.g. as regards the primitive mesoderm-cell. There is a typical invaginate gastrula, like that of *Planorbis*. A number of stages, which are figured, are described, showing the development of the external form.

A solid mass of mesoderm-cells acquires a lumen and becomes connected with an ectodermic duct to form the primitive kidney. There is no trace of internal aperture. An accumulation of mesoderm-cells in the region in front of the gut-rudiment forms the common basis of heart-chamber and kidney, which develope together. The heart arises as a groove-like invagination of the pericardial wall. The two cerebral ganglia originate separately in the ectoderm; the pallial (= pleural) ganglia also arise apart from one another, and apart from the cerebrals, as ectodermic proliferations, lateral and ventral to the velum and tentacle-rudiments; pedal, intestinal, and visceral ganglia also arise apart. These results are in contradiction to those of Sarasin, from whom indeed in most respects Erlanger differs. The importance of the paper is mainly its corroboration in *Bythinia* of what the author previously observed in *Paludina*.

Some Means of Defence in Eolididæ.†—M. E. Hecht concludes, from his observations of stained preparations of the papillæ of *Eolis glauca*, that the nematocysts contain a substance analogous to the contents of the mucous cells of epithelium, the fundamental constituent of which is probably mucin. By means of serial sections it is possible to follow without interruption the lumen of a well-marked canal, invested by a very distinct epithelium, which establishes communication between the cnidophoral sac and the hepatic cæcum. It follows, therefore, that the digestive-tube of these Molluscs does not only communicate with the exterior by means of the mouth and anus, but also by as many small orifices as each individual has papillæ. It is not in all, but only in some species that the dorsal appendages are easily detached. Most, and especially *Eolis papillosa*, preserve their papillæ, notwithstanding varied and repeated stimuli. The rare *Calma glaucoides* has no trace of a cnidophoral sac, though the papilla is well formed. This want appears to be due to degeneration, as the sacs are possessed by an allied species; the cause is, perhaps, to be found in the fact that this species, unlike most of its kind, does not feed on Cœlentera.

Structure of Proneomenia.‡—Herr J. Heuscher has investigated *Proneomenia Sluiteri* Hubrecht, of which only a few specimens have as yet been found. The animal is like a short, thick worm, 75–98 mm. in length, its skin is rough and stiff with calcareous spicules, a ventral

* MT. Zool. Stat. Neap., x. (1892) pp. 376–407 (2 pls.).
† Comptes Rendus, cxv. (1892) pp. 746–8.
‡ Jenaische Zeitschr. f. Naturwiss., xxvii. (1893) pp. 477–512 (4 pls. and 4 figs.).

furrow extends from mouth to cloaca, and in this furrow lies the extremely rudimentary foot.

The skin includes a strong chitinous cuticle with spicules of lime, and a thin hypodermis with glandular prolongations which enter, but do not traverse the cuticle. Some of these glands form spicules. In regard to the musculature Hubrecht's account is confirmed. The longitudinal fold which represents the foot is covered with ciliated epithelium; on each side there is a glandular cushion which secretes slime, and is innervated from the pedal commissure; there is no communication between ventral furrow and body-cavity. The author gives a useful tabular comparison of the nervous systems of *Proneomenia*, *Dondersia*, *Neomenia*, *Lepidomenia*, and *Paramenia*. In *Proneomenia* the anterior pleural ganglia are absent, and the pleural nerves arise directly from the brain. In regard to the vascular system, the author has certain corrections to make in Hubrecht's description; thus, the system is wholly lacunar. The heart remains in an embryonic state, consisting of an anterior and a posterior dorsal involution of the pericardium, and these pockets remain open above. Peculiar villi in the mouth, which Hubrecht was inclined to regard as respiratory, are without cilia, and are probably sensory palps. The histology of the entire gut is described. Finally, Herr Heuscher gives an account of the paired hermaphrodite gonad, the two ducts which lead from it into the pericardium, and the two "nephridial" canals which pass from the pericardium, and, uniting terminally, enter the cloaca.

δ. Lamellibranchiata.

Seat of Coloration in Green Oysters.*—M. J. Chatin finds that the most successful method of treating the gills of the Oyster is to use 1/500 solution of osmic acid, absolute alcohol, and safranin as a staining reagent. In pieces thus prepared it is easy to distinguish certain cells; they are found almost exclusively in the apical region of the branchial papillæ, where they are set with remarkable symmetry. These cells are of considerable size, regularly rounded; they have a diameter of more than 250 μ, and they may be called macroblasts. They are bounded by a protoplasmic layer so refractive as to resemble a cuticular membrane, though it is really a simple ectoplasm, principally formed of hyaloplasm. The chief part of the cell is formed by a very granular paraplasm, and the granulations, in Green Oysters, are coloured by a bluish pigment.

These granulations are protoplasmic, and must not be considered as of nuclear origin; the nucleus, in fresh cells, is almost always masked by the granulations. The cells one might be tempted to regard as symbiotic plant-cells, but they are not so; they are really constituent elements of the tissues of the Mollusc, and they are also found in white or colourless Oysters, where they only differ in the want of the coloured granulations.

Oysters from N.W. Coast of United States.†—Prof. R. C. Schiedt has discovered that, unlike other American Oysters, those from the coast of Oregon and Washington are, like *Ostrea edulis* of Europe, herma-

* Comptes Rendus, cxvi. (1893) pp. 264–7.

† Proc. Acad. Nat. Sci. Philadelphia, 1892, pp. 351 and 2.

phrodite; the ova are much larger than those of *O. virginica*, and the young undergo development in the gill- and mantle-cavities; in some points of structure they also present a resemblance to the European species.

Molluscoida.

a. Tunicata.

Blastogenesis in Botryllidæ.*—M. A. Pizon has, in an elaborate memoir, chiefly directed his remarks to the development of buds and larvæ, to asexual and to sexual reproduction. He has discovered in the Botryllidæ two epicardiac tubes, formed by two posterior diverticula of the primitive vesicle, and analogous to those found in allied stalked Ascidians; these tubes, however, are not isolated from the part of the primitive vesicle which gives rise to them, and, in the adult, they appear as the direct prolongation of the peribranchial sacs. The author considers that there has been a transportation of the blastogenetic faculty of the epicardiac tube of Polyclinidæ to another portion of the endodermic vesicle of the Botryllidæ; in other words, to the external membrane of each peribranchial cavity. This peribranchial blastogenesis and the consequent disposition of the ascidiozooids in radiating rows is a natural consequence of the mode of attachment. The peribranchial cavity appears to arise in two different ways; in *Appendicularia*, which is looked upon as the typical larva of Tunicates, the successive changes of the ancestral form have been such that the larvæ do not undergo the least metamorphosis; with the rest there has been retrogression, and so it happens that in some larvæ the peribranchial cavities are formed by invagination of the ectoderm, while in others they are, as in one of the ancestral forms, diverticula of the primitive endodermic vesicle.

M. Pizon has found that the vibratile organ commences as a dorsal diverticulum of the primitive endodermic vesicle, which appears at the same time as the peribranchial diverticula, the intestine, the heart, and the epicardiac tubes. This diverticulum then opens secondarily on the anterior part of the branchial vesicle, while it loses its hinder communication with the primitive vesicle; on the side of this latter it undergoes a more or less rapid atrophy. It would seem then that the vibratile organ is not formed by a simple cul-de-sac of the anterior part of the branchial sac, as Van Beneden and others have thought; consequently the homology with the hypophysis cerebri of Vertebrates, which they have suggested, cannot be maintained. The author believes that the vibratile organ represents the remains of an ancestral organ which played an important part in primitive Tunicates, but which has lost its functions in consequence of ontogenetic changes. He is of opinion that his views are confirmed by the homology which he has been able to establish between the different diverticula of the primitive vesicle of Crinoids and those of the primitive vesicle of the buds of compound Ascidians. He considers that the two peritoneal vesicles, the aquiferous vesicle and the endodermic prolongation of the stalk of Crinoids are respectively homologous with the peribranchial sacs, vibratile organ and epicardiac tube of Synascidians; and if the doctrines of evolutionists be correct, we must believe in the existence of an ancestral form common to

* Ann. Sci. Nat., xiv. (1893) pp. 1-386 (9 pls.).

Tunicates and Echinoderms. M. Pizon discusses, however, the possibility of adaptation being the cause of the resemblances which he points out. In any case he considers that these resemblances are important enough to attract attention.

In his discussion of the phenomena of the formation of colonies, he insists on the fact that an adult Botryllid is, at its death, replaced by the two ascidiozooids to which it has given rise, and which are each accompanied, as was their parent, by two younger and unequally developed generations.

In discussing the phenomena of physiological individuality, the author urges that the production of the primitive ascidiodeme by the egg itself confirms the laws of Perrier that (1) the egg of an organism that makes part of a colony tends to reproduce not only the organism in which it is found, but the entire colony of which the organism is part, and (2) in proportion as the organisms which constitute a colony become more closely one, the eggs which they produce tend to reconstitute more and more rapidly the whole of the colony. Attention is called to the existence in the Botryllidæ of a well-marked vascular colonial network; each new bud always remains in relation by a vascular tube (ectodermic pedicel). Thanks to this system of vascular tubes colonial life is realized to the highest degree in the Botryllidæ; the nutrient elements are shared, not only among the different ascidiozooids of one and the same system, but among all the systems of one colony. There would appear to be some community of share in the ova produced.

In the concluding portion of his memoir he deals with the development of the gonads.

New Respiratory Globulin of Tunicates.*—Dr. A. B. Griffiths has discovered a third form, which he calls γ-achrooglobin, of this respiratory globulin. He has found it in *Ascidia*, *Molgula*, and *Cynthia;* it exists in an oxidized and a reduced state, and 100 grm. absorb 149 ccm. oxygen.

Canalis Neurentericus Anterior.†—Dr. M. V. Davidoff noticed in his study of the development of *Distaplia magnilarva* that the place where the neuropore closes is not precisely the end of the nervous system, and that the latter extends somewhat further forward. In the subsequent development of the Ascidian, the anterior extension referred to above becomes hollow and opens by a canal into the pharynx behind the membrane which still separates the stomodæum from the gut proper. Now this canal is not an hypophysis, for the mouth of the Ascidian represents the hypophysis; it is best described by Kupffer's term "canalis neurentericus anterior."

β. Bryozoa.

Urnatella gracilis.‡—Mr. C. B. Davenport has made a detailed study of this interesting Bryozoon. He finds that the segmented stem consists of a bilaminate cuticle, the axial portion being formed of elongated cells, many of which are vacuolated, and surrounding which there is no intercellular substance. The musculature of the stalk

* Comptes Rendus, cxv. (1892) pp. 738 and 9.
† Anat. Anzeig., viii. (1893) pp. 301–3.
‡ Bull. Mus. Comp. Zool., xxiv. (1893) pp. 1–44 (6 pls.).

consists of radial sheets of fibrils, several of which develope in a single cell. Many of the vacuolated cells of the stalk end in flame-cells like the excretory tubules of Platyhelminthes. Yolk is developed in the cells at the base of the stalk in the form of five intercellular granules which later fuse; this process is accompanied by cell-degeneration. The lip of the atrium contains a sphincter, and resembles in its relations the so-called margin-thickening of the Ectoprocta. The epithelium of the tentacles encloses a parenchymatous core; a pair of muscles is present. The alimentary tract resembles generally that of the Pedicellinidæ. The nephridial tubules, which end blindly in flame-cells, open, with the anus and vas deferens, into a cloaca.

From the Urnatella-stalk there arise two kinds of buds; "branches" which are typically median, and "stolons" which are typically lateral. The segmentation of the stalk is probably an adaptation to the process of budding, which is accompanied by a greater liability of the wall of the stalk to rupture, and, therefore, by a greater need for the separation of the stalk into compartments.

In all Endoprocta the oral aspect of the buds is turned towards the centre of proliferation, and in all Bryozoa the aspect in which that end of the alimentary tract, which arises from the principal outpocketing of the atrium, lies is turned towards the gemmiparous zone. The stolons of the parent stalk of *Urnatella* habitually become free for the purpose of founding new stocks.

The author regards this genus as one of the Pedicellinidæ, and most nearly resembling *Arthropodaria Benedeni*.

Embryology and anatomy both indicate that the Bryozoa are closely allied to the Rotifera, the two groups having sprung from an ancestor common to them and the Mollusca. After the Rotifer-stem had branched off, the Mollusco-Bryozoan stem produced tentacles on the lateral ridges; the two groups soon separated, and the Bryozoa remained at a low level. The chief changes which the group has experienced are the acquirement of a body-cavity, the loss (?) of the protonephridia and sexual ducts in the Ectoprocta; the loss of the epistome in the Gymnolæma; the loss of the preoral ganglia; and the multiplication of the methods of reproduction, by regeneration, budding, division of stocks and statoblasts.

Nephridia of Cristatella.*—Dr. C. J. Cori has studied these organs, which were first seen by Verworn, by feeding and injecting *Cristatellæ* with powdered carmine. They lie to the anal side of the œsophagus, imbedded in that part of the body-wall which clothes the lophophore concavity. They consist of two canals communicating by open ciliated funnels with the cavity of the metasome, and uniting in an expanded bladder-like efferent duct, which opens to the exterior. The structure of these nephridia is described in detail, and their resemblance to the similar organs in *Phoronis* is noticed. They are not in themselves excretory in the strict sense, but serve for getting rid of the waste-products borne by the lymph or separated peritoneal cells.

γ. Brachiopoda.

Development of Brachial Apparatus of some Brachiopods.†—MM. P. Fischer and D. P. Oehlert, who have been able to observe the suc-

* Zeitschr. f. wiss. Zool., lv. (1893) pp. 626-44 (2 pls.).

† Comptes Rendus, cxv. (1892) pp. 749-51.

cessive modifications of the brachial apparatus in *Terebratella dorsata* and *Magellania venosa*, find that certain stages have often such a persistence that their transitory stages may be considered as distinct genera or true species. The first stage they call the premagadiform; the succeeding stage has a striking resemblance to the Magas-type; then follows that which Dall showed to be characteristic of his genus *Magasella*, on which follow the *Terebratella*, and in some the *Magellania*-stages.

Basing themselves on these views, the authors give tables to show the relations of various species to one another.

Arthropoda.

Nerve-centres of Arthropoda.*—M. H. Viallanes, who commences his sixth memoir on this subject with an account of the brain of *Limulus polyphemus*, gives the following table, which summarizes a number of important points:—

	Crustacea.	Insects and Myriopods.	Arachnida and *Limulus*.	
1st segment. Protocerebrum	Optic and psychical	centre innervating	the eyes.	Centres provided with præ-œsophageal commissures.
2nd segment. Deutocerebrum	Olfactory centre. Innervates 1st pair of antennæ. Furnish a root	Olfactory centre. Innervates antennæ. to the visceral	Tactile centre. Innervates cheliceræ and rostrum. nervous system.	
3rd segment. Tritocerebrum	Antennary lobe. Tactile centre. Innervates 2nd pair of antennæ.	Wanting.	Wanting.	Centres provided with post-œsophageal commissures.
	Œsophageal ganglion. Gustatory centre. Innervates labrum. Furnishes a root to the visceral nervous system.	Œsophageal ganglion. Gustatory centre. Innervates labrum. Furnishes a root to the visceral nervous system.	Wanting.	
4th segment. 1st subœsophageal ganglion	Inner-	vates	mandibles.	

The author's studies lead him to propose the following scheme of classification of the Arthropoda:—

- Arthropoda
  - Antennata
    - Biantennata
      - Myriopoda.
      - *Peripatus*.
      - Insects.
    - Quadriantennata — Crustacea.
  - Chelicerata
    - *Limulus*.
    - Arachnida.

* Ann. Sci. Nat., xiv. (1893) pp. 405–56 (2 pls.).

Origin and Relationships of Arthropoda.*—Prof. N. Zograf has an essay on this subject. The most important points upon which he wishes to insist appear to be the following:—

The cephalic invaginations of the embryos of all Arthropods are the remains of sense-organs which are identical with the cephalic sensory organs of Annelids, and are common to the ancestors of these animals. Future researches in the embryology of Arthropods should aim at the solution of the question of the existence in the embryo of the remains of segmental sensory organs.

In the embryos of Myriopods, and probably in those of other tracheate Arthropods, there are traces of the nephridia of the first postoral pair as well as of the appendages which correspond to these nephridia. Future researches must determine the presence or absence of postoral papillæ of the embryo, as well as their correspondence with the salivary glands or some other derivative of the primitive nephridia. The author thinks that the question of the homology between the ducts of the gonads of Chilognatha and the nephridia of the third and fourth segments of the Protracheata should be investigated. In his judgment the view that the Malpighian tubes are derived from nephridia is a pure hypothesis, the truth of which can only be asserted after detailed researches into the development of the Malpighian tubes of Myriopods and of the higher Arthropoda. Although some further research is needed, it appears probable that the elements from which the ducts of the gonads of Myriopods are derived owe their origin to the nephridia of annelidiform ancestors.

Prof. Zograf does not think that the difference in the histological structure of the nerve-chain is an obstacle against admitting the theory of the origin of the tracheate Arthropods from such ancestors; some parts, indeed, of the nerve-chain of the lower Tracheates present traces of the primitive histological structure. If the opinion of some authors that the coxal pores of *Peripatus* and the Myriopoda are the remains of the setigerous pouches of Annelids shall be shown to be correct, the theory of the origin of Tracheata from an annelidiform ancestor will have one support. At any rate, this theory, as elaborated by Kennel, is based on a number of ascertained facts.

The author is anxious to see the Crustacea ranged with the rest of the Arthropoda, and is of opinion that a revision of the embryogeny of Crustacea, from the point of view of their relationship to the other groups of Arthropods, is urgently needed. The most important problems are the presence or absence in adult or embryonic Crustacea of traces of the organs proper to Annelids or their supposed ancestors—that is to say, of segmental sensory organs, of nephridia, and of the cephalic sensory organs which are so well developed in the Capitellidæ. Before the hypothesis of the derivation of the Nauplius from the Trochosphæra can be taken to be correct, proofs must be found that the appendages of the Nauplius are homologous with those of Rotifers, or there must be a demonstration of the existence of remains of the ciliated ring or of a ring of separated nerve-cells or the existence of traces of the two cephalic nephridia which are found in Rotifers.

* Congrès Internat. de Zool., II. i. (1892) pp. 278–96.

a. Insecta.

Insects Injurious to Crops.*—Mr. C. Whitehead, a technical adviser to the Intelligence Branch of the Board of Agriculture, gives detailed notices of various insects (and fungi) noted in 1892 as attacking the crops of the farm, orchard, or garden. A new departure, made with the object of facilitating the identification of the pest, is the addition of carefully coloured plates, reproduced from sketches by Mr. Whitehead. One of the most severe ravages of a not very notable year were the attacks of the mustard-beetle—*Phædon betulæ*, the raspberry-moth—*Lampronia rubiella*, and the red spider—*Tetranychus telarius*, which was most troublesome in spring to gooseberry bushes, and, later in the year, to damson, plum, and peach trees; in the last few years red spiders have increased enormously, and have attacked various crops. Apples have been attacked by the Apple-blossom Weevil—*Anthonomus pomorum*, and by the Codlin Moth—*Carpocapsa pomonana*. The most general visitation was that of the Mangel fly—*Anthomyia betæ*; and very great injury was done by the minute larvæ of the Frit Fly. This report should interest a number of agriculturists and entomologists.

Hybridism among Insects.†—Dr. M. Standfuss states that the pairing or the attempted pairing of different species has been observed in almost all orders of insects, but hybrid offspring are known only in the case of Lepidoptera, e. g. *Saturnia spini* Schiff and *S. pavonia* L. The hybrids between a male of sp. A and a female of sp. B are not the same as the hybrids between a male of sp. B and a female of sp. A. The hybrid usually shows characteristics of both parents, but is not a precise intermediate form. "The male reproductive element determines the external features of the hybrid much more essentially than does the female," or, to put it more accurately, the external features of the hybrid are much more like those of the paternal species than those of the maternal species. Most of the hybrids are sterile.

Effects of Temperature in the Pupal Stage.‡—Mr. F. Merrifield has made a number of experiments on the effects of temperature in the pupal stage on the colouring of *Pieris napi*, *Vanessa atalanta*, *Chrysophanus phlæas*, and *Ephyra punctaria*. With regard to the first of these, experiments prove that some, but not all of the characteristic colouring depends, not on the particular emergence, i. e. summer or spring, to which the insect, when entering on the pupal stage, belongs, but on the temperature to which the individual pupa is exposed. In *C. phlæas* it appears that the principal effects on colour, &c., are produced not by long exposure to severe cold, but by exposure, during the period when the active part of the pupal stages has begun, to (1) great heat, producing duskiness or (2) moderate cold, producing vividness and intensity of colouring, smallness of spots, and great enlargement of the copper band on the hind wings. The difference, therefore, in appearance between *C. phlæas* from Southern Europe and *C. phlæas* from England is not necessarily to be attributed to the existence of races of different colouring,

* 'Report on Insects and Fungi Injurious to Crops,' London, Board of Agriculture, 1893, 60 pp., 10 pls. † MT. Schweiz. Entomol. Gesell., viii. (1893) pp. 386–96.
‡ Trans. Entomol. Soc. Lond., 1893, pp. 55–67 (1 pl.).

but may be due to the differences in temperature to which the individuals are exposed in the two climates.

Male Genitalia of Yphthima.*—Messrs. H. J. Elwes and J. Edwards have made a revision of this genus of Lepidoptera by the aid of the characters afforded by the male genitalia. Little use of these parts has been made by any other lepidopterists than Messrs. Godman and Salvin, though the experience we have proves that they present great stability of form in the groups which we are accustomed to regard as species; they remove the individual judgment as a factor in doubtful cases, and they afford a final appeal in cases of difference. The parts to be preserved are the tegumen, the two clasps, and the single chitinous piece which is known as the œdeagus. Mr. Salvin, by means of a combination of cardboard and cover-glass, produces a cell for balsam-mounting which possesses all the advantages of the ordinary cell, and which can be pinned in the cabinet. Although the authors believe that the use of these characters will be greatly extended, they see objections in the necessity of exercising patience and dexterity in making the preparations, and in the "mutilation" of specimens. On the whole, the application of the genitalia test shows that the species of these Insects are more numerous and the species less liable to vary than has been generally supposed.

Metamorphosis of Lepidoptera.†—Prof. E. Bugnion has a notice of the researches of M. J. Gonin. His chief results appear to be:—

(1) Part of the appendages of the head and thorax of the perfect insect arise, during the larval stage, from an evagination of a fold of the hypodermis which has previously been invaginated into the body.

(2) These appendages soon receive tracheæ and nerves which bud off from neighbouring trunks; M. Gonin shows, contrary to the opinion of Landois and Verson, that the tracheæ are not the cause either of the folding or of the expansion of the walls of the wing, but that these phenomena are rather due to the proliferation of hypodermic cells and to the resulting increase in surface.

(3) The buds for the wings are developed in the earliest larval stage, and may be seen in suitable sections as soon as the egg is extruded. The buds for the other organs are not visible till after the third or penultimate ecdysis of the caterpillar.

(4) The legs of the larva only contain the extremities of the homologous organs of the adult; the amputation of a leg of a larva destroys, therefore, only the extremity of a leg of an imago.

(5) The buds of the antennæ, jaws, and labial palps are folded on themselves at the base of the corresponding parts of the larva.

(6) The number of twelve thoracic discs, which was considered as typical by Weismann, is not found in Lepidoptera, while in the Hymenoptera the dorsal discs of the prothorax are wanting.

(7) As the germs of Lepidoptera are not discoid in form, they are better called imaginal buds or folds.

(8) These buds serve sometimes for the formation of new organs,

* Trans. Entomol. Soc. Lond., 1893, pp. 1–54 (3 pls.).

† Mittheil. Schweiz. Entomol. Ges., viii. (1893) pp. 403–7.

e. g. wings of Metabola, legs of Insects with apodal larvæ, and sometimes for the growth and transformation of organs already existing.

(9) Of the hypodermic envelope which encloses the bud, part persists and is regenerated, while part becomes useless and is detached.

(10) The part which persists serves at first to attach the developing appendage to the hypodermis of the larva, and, later on, regenerates more or less completely part of the integument. It is in this way that the hypodermis of the thorax is partly, and that of the head almost entirely, replaced by the imaginal epithelium which proliferates at the bases of the appendages.

(11) The buds of the wings do not share in the larval ecdyses.

(12) The network of tracheolæ of the alary buds is removed with the internal cuticle of the large tracheæ, at the time when the chrysalis-stage is reached.

(13) The permanent tracheæ of the wings appear as early as the third ecdysis, but they are not filled with air till the chrysalis-stage. There are eight to ten of them in each wing, and they give rise to a new system of tracheolæ.

(14) It is, too, at the beginning of the chrysalis-stage that the wings, limbs, antennæ, and gnathites take up the position which they occupy in the nymph.

(15) The expansion of the wings is partly due to the afflux of blood into the lacunar system which is contained between their two walls, and partly to the pressure of the air contained in their large tracheæ.

Pupæ of Heterocerous Lepidoptera.*—Dr. T. A. Chapman calls attention to some neglected points in the structure of the pupæ of these Lepidoptera, and their probable value in classification. There appear to be two very distinct types of pupæ in the Lepidoptera Heterocera, each of which presents such a constant set of characters that the members of each group must be more closely related together than to any of the other group. Light is thrown on the true relationships of the Macrolepidoptera, while the Pterophorids are shown to be unrelated either to Pyraloids or Alucitids; hints are given as to the division of the group Tineina.

The author brings forward evidence of the existence of a well-marked maxillary palpus in sundry pupæ whose imagines are without it, and he concludes with a tabular diagnosis of the groups of the Lepidoptera Heterocera.

Pocket-like Abdominal Appendages of Female Acræidæ.†—Herr A. F. Rogenhofer describes the variable form of these interesting appendages, which several entomologists have noticed. They have to do with copulation, and probably fall off after oviposition. In the African species they are most like the separable pockets of Parnassii; in American forms they are simpler conical solid processes.

Habits of Trigona.‡—Mr. J. H. Hart gives an account of some observations on a species of "wild bee" common in Trinidad. If put in a box they make it practically air-tight, and then form a

* Trans. Entomol. Soc. Lond., 1893, pp. 97–119.
† Verh. K. K. Zool. Bot. Gesell., xlii. (1893) pp. 579–81.
‡ Ann. and Mag. Nat. Hist., xi. (1893) pp. 327–9.

special entrance tube. This may in section be seen to be constricted in several places by discs, which leave only sufficient space for the passing of one bee at a time. If beaten back, therefore, from the first, they have still the chance of successively holding the inner ones. These constrictions and the sealing up are evidently adopted by the insects as a means of defence against their enemies. At nightfall, the orifice which admits of ingress and egress during the day is sealed completely over, only all but imperceptible orifices being left in the closing sheet of wax. Near daybreak this safeguard is regularly removed. This bee has no sting, and hence, we may suppose, the careful means of defence which it adopts.

Another species of *Trigona*, which has likewise no sting, is very pugnacious, and attacks persons coming near with a buzz and a hum similar to that of the common honey-bee. It fixes itself in the hair and produces a tickling feeling, which quickly induces a sensation of fear; "even when its character is known the attack (almost unconsciously) causes the intruder to retreat."

Self-mutilation in Larvæ of Phryganidæ.*—Gräfin M. v. Linden robbed a larva of *Limnophilus* of its covering. The creature crept about from stem to stem without seeming to find anything suitable for a new case. During the night of the second day it seems to have removed the tarsal joints from its first right and second left legs. It was not possible to say that an enemy had done it, for none was present.

Systematic Position of Strepsiptera.†—Prof. N. Nassonov discusses the systematic position of the Strepsiptera as indicated by the facts of postembryonic development and of anatomy. He has chiefly studied *Xenops Rossii*. The mouth-parts are found to be formed at first of two simple lamellæ, that is of an upper and a lower lip which bound the mouth; in the cavity of the mouth there is but a single pair of appendages, the "upper jaws," which are arranged like those of *Campodea*. The "lower jaws" are completely absent. The author does not agree with Siebold in stating that there is a difference between the male and female apodal parasitic larvæ, for he finds that the sexual distinctions only appear after metamorphosis. An account is given of the changes undergone by the two sexes. They may be summed up by saying that, while the male passes through a complete external and internal metamorphosis, accompanied by profound modifications of the organization of the larva, the female undergoes much less marked changes, and the organization of the adult female, sexual organs excepted, differs very little from that of the larval stage.

The chief points by which the Strepsiptera are distinguished from other Insects are: (1) the absence of posterior and inferior lips, the very feeble development of the "lower jaws" in the males, and their complete absence in the females; (2) the orifice of the mouth is at a distance comparatively considerable from the parts of the mouth; (3) the anterior pair of wings and the appendages of the male are specially modified; (4) the central nervous system is formed of three ganglia; (5) the female has no mid-gut; (6) there are no Malpighian vessels or cutane-

* Biol. Centralbl., xiii. (1893) pp. 81–3.

† Congrès Internat. de Zool., II. i. (1892) pp. 174–84.

ous glands; (7) there is direct communication between the testes and the unpaired sexual canal, which enlarges into a seminal vesicle; (8) the sexual canals form curved tubes and resemble the segmental organs of Annelids; (9) reproduction is pseudopædogenetic. After discussing the views of various systematists the author concludes that the Strepsiptera form a group which probably arose from the ancestors common to all the winged Insects; they represent an independent branch, which has deviated considerably from the other orders; the group was probably formed later than the Orthoptera, Pseudoneuroptera, or Neuroptera.

Coccus cacti.*—Dr. Paul Meyer has made some welcome observations on living cochineal insects He gives a preliminary quotation from Taschenberg (in Brehm's 'Thierleben'), which shows the need for some accurate observation. According to Blanchard, entomologists are in doubt as to whether the female is oviparous or viviparous, the fact being that both opinions are in a measure true. The embryos develope completely within the mother, but are born within egg-shells, which, as well as the first larval skin, they soon leave behind them.

Apart from the diffuse fatty body and the yolk, no organ has the red pigment; it does not occur in skin, gut, salivary glands, excretory tubules, or blood. The carminic acid is a product of the animal's metabolism. The import of the red pigment in the economy of the animal remains a riddle. The wax or coccerin secreted by the wax-glands, which are especially abundant around the anus, serves to enclose the excreta so that the body of the insect is not soiled. The secretion passes out in long threads by the "wax-hairs," *through the membrane*, which has no visible pores, and in short curved threads by the "wax-pores," but here also *through the membrane*. As to the wax-cells, they are merely larger and longer hypodermis cells, but in them the observer could not detect the coccerin.

It is well known that the males develope within a cocoon, which is open posteriorly. This consists of wax threads plus the secretion of cement-glands, which are much more abundant on the males than on the females.

In the gut of the female the peculiar invagination of a portion of the œsophagus and mid-gut into the rectum, as in several Coccidæ, does not occur. There is a salivary pump. There are only two Malpighian tubules. No hint of a heart or even of a dorsal vessel was seen.

Systematic Position of Phytophthires.†—Herr J. Krassilstschik concludes from his anatomical study of *Phylloxera* that it is an archaic form intermediate between Aphidæ and Coccidæ. A special family of Phylloxeridæ (including *Phylloxera* and *Chermes*) must be established, and regarded as primitive among Phytophthires, and as representing the stock from which Aphidæ and Coccidæ have diverged.

Gryllidæ of Hungary.‡—Mr. Gyula Pungur's monograph aims at giving not only a systematic description of the Gryllodea, but also an account of their habits, with a special description of the musical pheno-

* MT. Zool. Stat. Neapel, x. (1892) pp. 505–18 (1 pl.).

† Zool. Anzeig., xvi. (1893) pp. 69–76, 85–92, 97–102.

‡ 'Hist. Nat. des Gryllides de l'Hongrie,' Budapest, 1891 [received 21/4/93], 95 pp., 6 pls.

mena and the correlations of their surroundings. The body of the text is in Hungarian, but there is a French *résumé*.

In dealing with the anatomy (orismology) the author combats the view of M. Bunnier de Wattenwyl that the head of Gryllids should be reduced to three segments, and states that he thinks there are four; the first described is the basal, or that adjacent to the thorax, and its lateral membranes are formed by the cardines; the one in front has the mentum for its sternal part; in the second segment the galeæ and palpi form the lateral membranes, and the first bears the mandibles. The elytra are found to vary in form and size in different species; a detailed account is given of their neuration.

In the biological portion the author first gives an account of the development and ecdyses, and then treats successively of the habitations of these Insects, which are generally in dry ground, of the galleries that they make, of their food, and their habits of hibernation and migration.

A full account is given of the elytron as a musical instrument, but the males only are sound-producers; the elytra of either side are sometimes similar, and sometimes dissimilar; indeed the left elytron is sometimes quite transparent. The organs which produce the song are the lima and the arculus; the former of these lies below the elytron, and is formed of a row of teeth of varying forms; the latter ordinarily consists of two small branches of the postcosta. The author has been able to determine the "tempo" of the sounds.

In the concluding portions of the general part, copulation, oviposition, modes of defence, and the work performed above and below the ground are among the subjects treated of. The second part of the work is systematic, and the whole concludes with a bibliographical list.

β. Myriopoda.

Life-history of Julidæ.*—Herr C. Verhoeff corrects a previous communication in which by a slip the *Schaltstadium* in the life-history of male Diplopoda was compared with the transition from larva to nymph in Holometabolic insects. The true analogies are as follows:—The last stage (with a ventrally closed seventh trunk-segment) is compared with the nymph, the *Schaltstadium*, which lasts for months, with the sub-imaginal stage, the mature male with the imago.

δ. Arachnida.

Fixation of Parasitic Hexapod Larvæ of Acari.†—M. S. Jourdain finds that there are two modes of fixation. In those that live on *Lagria hirta* and *Phalangium opilio* the rostrum is armed with two hooked mandibles, which perforate the chitinous envelope of the host. In a larva found on *Miris viridis* the attachment is of a kind that does not seem to have been yet described; the rostrum is produced into an irregularly branched trunk, and the branches make their way among the sub-integumentary tissues; the walls of this branching tube are thick and transparent, and each branch ends in a sucker which is perforated in its centre.

* Zool. Anzeig., xvi. (1893) pp. 84–5.
† Comptes Rendus, cxv. (1892) pp. 621 and 2.

Phytoptidæ.*—Prof. G. Canestrini gives an account of this family. This is a shortened statement of their general characters:—The body is divided into an anterior portion ("cephalothorax") with limbs, and a posterior portion (abdomen) without limbs; there are free, short, simple, three-jointed palps, aciculate mandibles, a proboscis adapted for suction; there is an absence of tracheæ, special circulatory organs, and eyes; the integument is delicate, the shape vermiform, and there are two pairs of five-jointed limbs; the sexes are separate and not markedly dimorphic, the gonads are unpaired; in post-embryonic development there are two moults and two immature forms. An account is given of the various ways in which these parasites affect plants, producing galls and other deformities, sucking leaves and fruits, and so on. The author gives diagnoses of the genera:—*Phytoptus*, *Cecidophyes*, *Phyllocoptes*, *Tegonotus*, and *Oxypleurites*, a detailed description of seventy species, and a list of the plants which are attacked.

Striped Harvest-Spider.†—Mr. C. M. Weed makes this *Phalangium* the text of an interesting study in variation. Say, in 1821, described *P. vittatum* and *P. dorsatum*. From the examination of several hundreds of specimens the author concludes that we have to do with a single very variable species, in which natural selection has increased the size of the body and the length of the legs to the southward (of the United States) and shortened them in the north.

Affinities and Origin of the Tardigrada.‡—Prof. J. von Kennel accepts and starts from Plate's view that the Tardigrada are related to the tracheate Arthropoda, but he cannot assent to the doctrine that they are lower than *Peripatus*. He points out, on the other hand, the great resemblances between Tardigrades and greatly modified tracheate larvæ, and urges that the differences that there are between them are due to the advanced degeneration of the "Bear-animalcules" and, possibly, to neomorphs. In considering the embryology of Tardigrades we must bear in mind that it may have undergone great secondary modifications.

ε. Crustacea.

Nervous System of Heart of Crab.§—MM. F. Jolyet and H. Viallanes have studied the physiology of the acceleration and inhibition of the heart of the Crab. In a general way strong stimuli slow the cardiac rhythm, while slight and prolonged stimuli accelerate it. Both accelerating and inhibiting cardiac centres are confined to the subœsophageal mass. The authors have not been able to find in the Crab the cardiac nerve which has long been known in macrourous Crustacea, and which has been regarded as the only accelerator of the heart.

Nephridia and Body-cavity of Larva of Palæmonetes varians.‖ Mr. E. J. Allen has a preliminary communication on the development of this Crustacean; his investigations lead him to suggest that both

* Atti Soc. Ven.-Trent. Sci. Nat., 1893, pp. 49–98 (16 pls.).

† Amer. Naturalist, xxvi. (1892) pp. 999–1008 (1 pl.).

‡ SB. Nat. Ges. Univ. Dorpat, ix. (1892) pp. 504–12. See Ann. and Mag. Nat. Hist., xi. (1893) pp. 197–204.

§ Ann. Sci. Nat., xiv. (1893) pp. 387–404.

‖ Proc. Roy. Soc., lii. (1893) pp. 338–42.

enterocœle (true cœlom) and pseudocœle are present; the former consists of the dorsal sac, green-gland and shell-gland, or the end-sacs of these organs, together with the genital organs and their ducts; the pseudocœle consists of the heart and arteries, the pericardial cavity, the central cavity of the thorax, with the lateral cavities and the cavities of the limbs, and the various sinuses of the abdomen; as the pseudocœle is filled with blood it can be termed a hæmocœle.

Pelagic Copepoda of Naples.*—Dr. W. Giesbrecht, in this elaborate and most beautifully illustrated monograph, deals with the systematic and faunistic relations of the Pelagic Copepoda of the "Gulf of Naples and adjoining sea." Limited as is the scope of the work it is the result of ten years' labour, part of which has been devoted to the study of Copepods from other parts of the world, so that the terms of the title, "der angrenzenden Meeres-Abschnitte," are hardly correct. The Copepoda are divided into two sub-orders:—

I. Gymnoplea	..	Tribe i. Amphaskandria for the family Calanidæ.
		„ ii. Heterarthrandria for the families Centropagidæ, Candacidæ, and Pontellidæ.
II. Podoplea	..	Tribe i. Ampharthrandria for the Mormonillidæ, Cyclopidæ, Harpactidæ, and Monstrillidæ.
		„ ii. Isokerandria for the Oncaidæ and the Corycaidæ.

More than 700 pp. are devoted to the description of the species, with their synonymy, localities, and analytical keys.

The second part of the work is faunistic. The ocean, as judged by its pelagic Copepod-fauna, is divisible into three primary areas: — a warm, a north-cold, and a south-cold; all three have a number of peculiar species, but the proportion (85 per cent. of all species) is much larger for the warm area than for the north ($5\frac{1}{3}$ per cent.) or the south ($1\frac{2}{3}$ per cent.). Pelagic Copepods may live as deeply as 4000 metres and it appears as if the limits between the three faunal areas hold not only for the surface fauna, but also for the species that live in the deep. It is doubtful whether there are any pelagic Copepods which live exclusively at great depths. The distribution of other holopelagic animals appears, on the whole, to agree with that of Copepods. It may be supposed that the daily migrations of pelagic animals are under the influence of light, and their annual migrations under that of temperature; but besides these periodic movements numerous pelagic species exhibit yet another which may be called ontogenetic migration.

This is another of the magnificent monographs which will add to the already great reputation of the publications of the Zoological Station at Naples.

Lateral Eye of Pleuromma.†—Dr. J. Richard has found the three known species of this Copepod in the collections made by the 'Hirondelle.' In the female of *P. abdominale* the lateral eye is more often on

* 'Fauna und Flora des Golfes von Neapel, &c. XIX. Pelagische Copepoden,' 4to, 1892, 831 pp. and atlas of 54 pls. † Zool. Anzeig, xv. (1892) pp. 400–2.

the right than on the left, in proportions which vary with different localities; in the males the eye appears to be always on the left side. In *P. gracile* the eye is always on the right side, in both sexes. *P. xiphias* seems to follow the same rules as *P. abdominale*. Unlike Dr. Brady, the author has not found one *Pleuromma* without a lateral eye.

In minute structure this organ does not resemble the unpaired or median eye which is so common in Copepoda. The projection which forms the organ is constituted by the continuation of the cuticle, has a black ring at its base, and has the convex part almost colourless. The chitin is very fragile; below the swollen portion of the cuticle there is a small, more or less spherical mass, which appears to be formed of a considerable number of more or less spherical bodies. In the not very well preserved specimens at his disposal, the author was unable to establish the presence of a nerve, and, indeed, for further details a supply of fresh specimens is needed.

Lateral Organ of Pleuromma.*—Dr. F. Dahl divides the species of *Pleuromma* into three groups:—(*a*) *P. gracile* and *P. boreale* sp. n.; (*b*) *P. abdominale* and *P. xiphias;* (*c*) *P. robustum* sp. n. and *P. quadrangulatum* sp. n. He states their specific diagnoses and geographical distribution. He believes that the lateral organ is luminous and not optic, on account of its unilateral position, its histological structure, and its resemblance with the luminous organ of *Euphausia*. Among Copepods luminosity and the possession of a lateral organ go together, though perhaps not constantly.

Commensals of Mediterranean Turtles.†—MM. E. Chevreux and J. de Guerne have a note on the Crustacea found commensal on *Thalassochelys caretta; Hyale Grimaldi*, *Platophium chelonophilum*, numerous examples of *Caprella acutifrons*, *Tanais Cavolinii*, *Lepas Hilli*, and *Conchoderma virgatum* are reported. *Platylepas bissexlobata*, found in 1832 on Mediterranean Turtles, does not appear to have been seen again.

New Caligidæ.‡—Prof. P. J. Van Beneden gives an account of some new species of these parasitic Copepods from Africa and the Azores. What most struck the author was the extraordinary abundance of commensals of inferior rank which were found on these parasites themselves. Some were literally covered by Campanulariæ, Acinetæ, or *Podophrya*. A proof of how rapidly the surface of the body is invaded is shown by the fact that the ovisacs even were covered before the eggs had escaped. The new forms are called *Caligus Dakari*, *Nogagus angustatus*, *Calina brachyura*, *Pupulina Flores*, and *Caligera difficilis*.

Daphnia.§—Prof. V. Capanni has published a study of *Daphnia pulex*, telling in a frank way what he has observed under his Microscope as to the structure and life of this familiar Crustacean. The booklet, although accompanied by a bad figure of the animal, may be of use in inducing students to share the author's joys of observation.

* Zool. Anzeig., xvi. (1893) pp. 104–9.
† Comptes Rendus, cxvi. (1893) pp. 443–5.
‡ Bull. Ac. Roy. Belg., lxii. (1892) pp. 241–62 (4 pls.).
§ 'La Dafnia,' Reggio Emilia, Tip. Artigianelli, 1892, 8vo, 24 pp., 1 fig.

Structure and Growth of Calcareous Test of Balanus.*—M. A. Gruvel divides the test of *Balanus* into the wall and the base; he finds that the test contains histological elements which disappear on decalcification, and that it is difficult to grind down sections sufficiently thin to allow of the easy study of these elements. By a method which he does not now describe the author has been able to make more complete researches. The wall of the test may be found to consist of three parts; there is an internal portion produced by the mantle, an external part secreted by test-glands, and a third part formed by calcified columns.

The innermost part is divisible into three layers; an internal structureless layer, which is traversed by numerous small canals, which pass to the base of as many small setæ which are perforated at their extremity, are disposed in parallel rows, and have the liquid of the general cavity circulating in them. This layer is what Darwin called the opercular membrane, and, in consequence of their function, the author proposes to call the setæ respiratory. Between and outside these rows there is a true epithelium, formed of irregular polygonal cells, with large nuclei. More internally there is a series of concentric layers formed of a structureless transparent membrane, marked by irregular perforations throughout its whole extent.

The second part exhibits, in a non-decalcified section, true calcareous glands, set at regular intervals, the excretory canal of which passes directly to the exterior; the more early formed glands are often completely calcified, when there are formed externally to them young glands which generally make use of the excretory canal of their predecessor. The cellular structure can best be studied in the young glands; in them there may be seen an epithelium formed of flattened cells, and leaving in the midst of the cul-de-sac a free space which is often filled with granulations. These glands disappear completely when the wall is decalcified, and their impression only is seen on the decalcified intermediate tissue.

The outermost layer is formed by a delicate cuticle, which is irregularly folded, and carries hairs set in parallel rows in which all kinds of vegetative growths are developed. The calcified columns occupy the whole height of the wall, and consist of a concentric series of layers of a structureless dotted membrane, absolutely the same as that in the inner portion of the first pair. Between the concentric layers there are numerous small cells, completely enclosed in a thick black pigment. In their upper part these columns or columellæ are solid, but in the lower part there is a central cavity which contains a large number of fat-cells, with endothelial cells in concentric rows. The base is formed of several superposed layers.

The test increases in diameter, thanks to the foliaceous folds which separate the segments of the wall; the folds of two adjacent segments work into each other; they are fixed at their inner edge, free at their outer, and secrete both laterally and externally. The whole of the wall is traversed by canals.

The terga and scuta have exactly the same structure as the inner portion of the wall; their growth is effected by the mantle, and they have on their outer surface respiratory setæ and a cellular epithelium.

* Comptes Rendus, cxvi. (1893) pp. 405-8.

Vermes.

a. Annelida.

New Pelagic Polynoid.*—Dr. E. von Marenzeller, under the name of *Nectochæta Grimaldii*, describes a new genus of Polynoids; very few members of this family are known to be pelagic, as one only is known from Algiers and one from Ceylon. The present new form was taken by the Prince of Monaco in the yacht 'Hirondelle' in 48° 24′ 48″ N. latitude and 20° 38′ 30″ W. longitude, or at a very great distance from any land.

The principal character of the new genus consists in the extraordinary elongation of the setæ of the neuropodium; these setæ serve for swimming. Only a single example was taken, and it was colourless and transparent; by the structure of its cephalic lobe *Nectochæta* is shown to be allied to *Lepidonotus*.

New Earthworms.†—Mr. F. E. Beddard has notes on sixteen species of earthworms, mostly new, from various localities. Of the Acanthodrilidæ he describes *Octochætus* g. n. (*O. thomasi* and *O. huttoni* spp. nn. from New Zealand), in which he places various species from New Zealand previously referred to *Acanthodrilus*; the points of distinction between *Benhamia* and the new genus are insisted on. *Acanthodrilus smithi* and *A. paludosus* are species from New Zealand, which belong to the restricted genus *Acanthodrilus*. *A. falclandicus* and *A. aquarum dulcium* are also described. *Benhamia whytei* sp. n. was found in Nyassa-Land, and from Lagos comes *Benhamia crassa* sp. n.

Of the Cryptodrilidæ *Microdrilus saliens* g. et sp. n. comes from Singapore, Java, and Penang; the largest specimens are little more than an inch long. A fresh diagnosis is given of Perrier's genus *Perionyx*, one new species of which is described, while there are notes on *P. excavatus* and *P. macintoshi*. *Moniligaster*, which has hitherto been found in the Old World only, is now represented in the Bahamas by *M. bahamensis*. A new species from Durban is provisionally referred to the genus *Eudriloides*.

Of the Geoscolecidæ *Trichochæta barbadensis* sp. n. is described from a single specimen, which came from Barbadoes. *Ilyogenia africana* g. et sp. n. came from Durban; it is, perhaps, most nearly related to *Anteus* and *Rhinodrilus*.

New Species of Perichæta.‡—Dr. D. Rosa describes *Perichæta fasciata*, *P. æliana*, *P. enganensis* spp. nn., and *Urochæta corethrura* F. Müller, forms collected by Dr. E. Modigliani in the island of Engano, near Sumatra.

Segmental Organ of Enchytræidæ.§—Prof. H. Bolsius is not satisfied with the descriptions which have been given of this organ. Thus, d'Udekem, Eisen, Claparède, Vejdovsky, Michaelsen, Benham, Ude, describe and figure a single ciliated canal, whereas it bifurcates and subdivides into a complex anastomosis. The canaliculi reunite in

* Bull. Soc. Zool. France, xvii. (1892) pp. 183–5.
† Proc. Zool. Soc., 1892 (1893) pp. 666–706 (2 pls.).
‡ Ann. Mus. Civico Stor. Nat. Genoa, xxxii. (1892) pp. 542–8.
§ Anat. Anzeig., viii. (1893) pp. 210–5.

trunks, and finally into one collecting canal. There is, as Vejdovsky described, a urinary vesicle between the collecting canal and the exterior, but the Bohemian authority did not describe this accurately. It consists of two superposed cavities; the upper, into which the collecting canal opens, is spherical; the lower, in open communication with the upper, is cylindrical or pyriform; the two cavities are surrounded by the same cellular material as occurs around the collecting canal and the canalicules; there is not a trace of a special cellular boundary.

New Tubificidæ.*—Dr. Harriet Randolph establishes a new genus *Embolocephalus*, with two species—*E. velutinus* (= *Sænuris velutina* Grube) and *E. plicatus* sp. n. The worms have a sheath of viscid secretion, with which bacteria and extrinsic particles are associated. There are no eyes, but there are sensory papillæ in rings around the body. The head is retractile. There are dorsal setæ on all the setiferous segments.

Salivary Glands of Hirudinea.†—Prof. Leuckart states that the efferent ducts of the unicellular salivary glands of *Hirudo* all run forwards, and are gradually collected into three thick cords; these lie on the inner side of the three long abductors of the jaws, and may therefore be easily taken for parts of these muscles; their granular appearance and their histological characters show their true nature. These cords pass into the substance of the jaws, where they spread out; the number of the bands correspond to the number of the teeth, but before the cords reach the roots of the teeth they divide into two diverging halves which pass to the spaces between the teeth, where they open. These facts explain how the wounds made by the jaws are at once moistened by the secretion of the salivary glands, and have an important bearing on Haycraft's discovery of a substance secreted by the Leech which prevents the coagulation of the blood.

Terrestrial Leech from Chili.‡—M. R. Blanchard has a note on Grube's *Hirudo brevis*, which he thinks should be placed in a new genus to be called *Mesobdella*, as it is intermediate between the Glossiphoniidæ and the Hirudinea. Among the latter it approaches *Hæmadipsa* in its mode of life and the arrangement of its eyes; there is, however, a marked condensation of the somites.

Notes on Hirudinea.—Dr. R. Blanchard gives a description of *Glossiphonia marginata*;§ though one of the most common of European species, no one has ever given a rational description of it, or fixed its distinctive characters in a certain way. With affinities to *G. tesselata*, it is distinguished by its distinct head, which carries only two pairs of eyes, the clearer tinge of its yellow spots, and the presence of a mediodorsal row of similar spots.

In his next notice ‖ Dr. Blanchard gives a description of *G. sexoculata*,

* Jenaische Zeitschr. f. Naturwiss., xxvii. (1893) pp. 463–76 (3 pls.).
† Ber. Verh. Ges. Leipzig, vi. (1893) pp. 556–8.
‡ Comptes Rendus, cxvi. (1893) pp. 446–7.
§ Bull. Soc. Zool. France, xvii. (1892) pp. 173–8 (2 figs.).
‖ Tom. cit., pp. 178–82 (2 figs.).

which appears to vary very much in size and hue; it seems to be most nearly allied to *G. catenigera*, which has, however, only one pair of eyes, but the number of eyes is not, apparently, a character of generic importance in the Glossiphoniidæ.

In another notice * the author identifies the unnamed Australian *Branchellion* mentioned by Dr. J. D. Macdonald (1876) as *B. punctatum* of Baird, of which, as of *B. imbricatum* and *B. lineare*, he gives concise diagnoses.

Dr. Blanchard's notice † of *Nephelis atomaria* is a preliminary work in which he points out the essential characters in the morphology of the Nephelidæ. There is also a note on *N. octoculata* and descriptions of two new species, *N. gallica* and *N. tergestina*.

β. Nemathelminthes.

Muscular Force of Gordius.‡ — Prof. L. Camerano has made a number of experiments with *Gordius tolosanus* and *G. pustulosus*. The maximum weight which they can bear and yet contract varies from 2 to 4 grammes. The maximum weight which a square centimetre of muscle can support without breaking is 14262·64 grammes for *G. tolosanus* and 13730·28 for *G. pustulosus*.

New Species of Gordius.§ — Prof. L. Camerano describes a new species of *Gordius* (*G. Modigliani*), found by Dr. E. Modigliani in the island of Engano, near Sumatra. It most nearly resembles *G. Bouvieri* Villot and *G. sumatrensis* Villot, but is quite distinct.

Ecdysis of Filaria Sanguinis Hominis.‖ — Dr. P. Manson, noting the statement of M. Zune that some specimens of this *Filaria* have no sheath, but swim about naked in the blood, made some fresh observations and experiments. He finds that in newly drawn blood the worm is invariably enclosed in a loose sheath; but in some slides which were subjected to a frosty night, he observed that many of the parasites had quitted their sheaths, while others were vigorously endeavouring to do so. The blood on these slides had become thickened by the diffusion of hæmoglobin, and it was the viscidity of the blood that enabled the worm to force its way out of its sheath. The author has several times chilled and thawed blood, and successfully reproduced the process of ecdysis.

These chilling experiments explain the *rationale* of what actually happens in a natural way at another period in the history of the *Filaria*. In the stomach of a filaria-charged mosquito the blood is of a similarly viscid character, and here the worms have left or are trying to leave their sheaths, before travelling through the walls of the viscus and making their way into the thoracic muscles of the insect. The author describes the organs and process by which the perforation of the wall is effected.

* Bull. Soc. Zool. France, xvii. (1892) pp. 222 and 3.
† Tom. cit., pp. 165-72 (5 figs.).
‡ Atti R. Accad. Sci. Torino, xxviii. (1892-3) pp. 221-33.
§ Ann. Mus. Civico Stor. Nat. Genoa, xxxii. (1892) pp. 539-41.
‖ Brit. Med. Journal, No. 1685 (1893) pp. 792-4 (4 figs.).

Avian Entozoa.*—Dr. E. Linton has a report on the entozoic parasites of the Birds examined during a natural history survey of the lakes and streams of the Yellowstone National Park, Wyoming, the trout of which are much infested by parasites. The most interesting new form described is a Cestode parasitic in the duck *Œdimia americana*, and called *Epision;* the anterior part of the body is singularly modified into an organ for absorption and adhesion. A few species collected in Mexico are also described in this paper.

γ. Platyhelminthes.

Monograph of Turbellaria of Black Sea.†—Dr. Sophie Pereyaslawzewa divides her monograph into three parts, the first of which deals with the anatomy, the second with the embryology, and the third with the genera and species of the Turbellaria of the Black Sea.

The author objects to the term Acœla, which she replaces by Pseudoacœla for several reasons; the name leads to an impression which has been the cause of some of the errors of modern students of Turbellaria; the facts of embryonic development show that the "acœlism" is by no means a primary phenomenon, as some authors have stated; anatomical study and that of living animals show that it does not exist in adult Acœla. Embryonic development proves conclusively the existence of the gastric cavity in the embryo of the Acœla.

The genera described in the tribe Pseudoacœla are *Schizoprora*, *Aphanostoma*, *Convoluta*, *Darwinia* [g. n.], *Macrostoma*, *Promesostoma*, *Proxenetes*, *Hyporhynchus*, *Macrorhynchus*, *Schultzia*, and *Opistoma;* of the Alloiocœla, we have *Acmastoma*, *Allostoma*, and *Monotus*. A number of new species are described.

Distoma Cysts in Heart of Fish.‡—Dr. O. Zacharias found that the heart of a *Coregonus muræna* caught in Lake Plön was covered with little white dots. These were present in the anterior and posterior chamber, and also in the bulbus. Microscopical examination showed that these little bodies were cystic forms of a Trematode. There were altogether from 200 to 300 of these cysts.

Ectodermic Tissues of Cestoda.§—Prof. N. Zograf brings forward some evidence in favour of the view that there is a true ectoderm in adult Cestodes and in the six-hooked embryos. He hopes that those who are not satisfied with his demonstration will at least allow that certain facts which appear to prove the absence of this layer are the results of incorrect observation; the existence of animals without ectodermic tissues he regards as a paradox.

Development of Cercaria of Helix hortensis.‖—Prof. F. Blochmann comes to the conclusion that the larvæ of *Distomum caudatum* passed with the fæces of the hedgehog (*Erinaceus*) make their way into the snail (*Helix hortensis*), where they attain their cercaria-stage; when

* Proc. U.S. Nat. Mus., xv. (1892) pp. 87–113 (5 pls.).
† Odessa, 1892 [1893], xx. and 303 pp., 16 pls.
‡ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 752–3.
§ Arch. Zool. Expér. et Gén., x. (1892) pp. 331–44 (1 pl.).
‖ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 649–52.

the snails are eaten by the hedgehog they return to the intestine where their parents lived.

δ. Incertæ Sedis.

New Species of Pedalion.*—Herr K. M. Levander has found at Helsingfors a species of *Pedalion* which he believes to be distinct from the widely distributed *P. mirum*, and which he proposes to call *P. fennicum*. Some of the reasons for which he distinguishes it are:—(1) the absence of the two tentacles with fine hairs on the dorsal side of the hinder end; from this he concludes that the presence of "two stylate appendages on the posterior dorsal surface" is not to be considered as a generic character; (2) the lateral tentacles occupy a more median position than in *P. mirum*; (3) the setæ of the two lateral pairs of processes are equally developed on the dorsal and ventral surfaces, and there is no striking difference in the size of these processes; (4) the unpaired ventral process only just projects beyond the hinder lip of the body. Only females have as yet been observed; they are 0·229 mm. long, and ordinarily carry one or two reddish eggs attached to their hinder end. The author states † that Dr. Hudson is of opinion that this species is distinct from his *P. mirum*.

Moss-dwelling Cathypnidæ.‡—Mr. D. Bryce has some notes on the habits of these forms, and describes five new species, which he calls *Distyla clara*, *D. agilis*, *D. inermis*, *Monostyla bifurca*, and *M. galeata*; they were all (except *D. agilis*) found at Sandown, Isle of Wight; it was found in Epping Forest, as was also *D. inermis*.

Echinoderma.

Development of Antedon rosacea.§—Dr. O. Seeliger treats at great length of the development of this Crinoid. When the sixteen-cell stage is reached by the unequally segmenting egg a groove appears in the region of the animal pole which runs parallel to the equator. The pressure of the small cells closes the cleavage cavity at the animal pole; this is not effected at the vegetative pole till the forty-eight-cell stage is reached. The gastrula is formed by invagination at the vegetative pole in such a way that the primary axis of the egg is exactly that of the embryo and the later larva; the mesenchym arises from the endoderm.

The free-swimming larva has a proper nervous system, which is provisional only; the apparatus first noted by Bury at the anterior pole is highly complicated; the cells that compose it are partly sensory and partly indifferent supporting cells; both kinds of elements are rod-shaped. The inner ends of the supporting cells are blunt, while those of the sensory cells are continued into a fine process, which makes its way into the layer of nerve-fibres. This last is of some thickness, but near the periphery becomes suddenly thinner. It is supported by a basal membrane, which appears very early in the course of embryonic development. Before the cells of the apical spot become differentiated into sensory and

* Zool. Anzeig., xv. (1892) pp. 402–4. † Op. cit., xvi. (1893) pp. 26 and 7.
‡ Science Gossip, 1892, pp. 271–4 (5 figs.).
§ Zool. Jahrb. (Anat. u. Ontog.), vi. (1892) pp. 161–444 (11 pls.); Zool. Anzeig., xv. (1892) pp. 391–3.

supporting, a number of ectoderm-cells leave the epithelium, pass inwards and become ganglionic cells. The whole of this nervous system disappears soon after the larva becomes fixed, and it is not for two or three weeks that an extremely fine nerve-ring appears; this is formed altogether from the ectoderm, and is the nervous system described by Ludwig. In the oldest larvæ at his disposal the author was unable to see the rudiments of the nervous system described by Jickeli and Carpenter.

Aboral Vascular Lacunæ in Ophiothricidæ.*—Sig. A. Russo describes a connection between these lacunæ and the stomach in *Ophiothrix fragilis* and *O. echinata*.

New Bilateral Holothurian.†—Prof. E. Perrier describes, under the name of *Georisia ornata*, a Holothurian from the Mozambique. It has a marked bilateral symmetry, and though small (17 mm. long) recalls the Elasipod *Psychropotes*, ending as it does in a sort of tail. The resemblance, however, is altogether external, and *Georisia* is one of the Dendrochirotæ, and a member of the subfamily Psolinæ. The author gives a detailed comparison between *Psolus* and this new genus, and shows that, notwithstanding its peculiar appearances, *Georisia* is less aberrant from the normal Holothurian type even than *Psolus*.

Cœlentera.

Digestion of Cœlentera.‡—Dr. M. Chapeaux has been able to convince himself that in the siphonophorous forms *Apolemia uvaria* and *Diphyes acuminata* the endodermic cells are true phagocytes, and that they are capable of fusing into a large plasmodium when they require to digest bodies which are relatively large.

The author has investigated the action of the digestive ferments of Actiniæ on starch, cellulose, chlorophyll, and fats. Starch is converted into glucose, but neither cellulose nor chlorophyll are digested; fats undergo emulsion and are broken up, and more rapidly in an acid than in a neutral or alkaline medium. As may be supposed, the ferments of Actiniæ are powerless against Algæ. Similar statements may be made as to the digestive power of Siphonophora and craspedote Medusæ. At the same time it is not to be supposed that the digestion of Cœlentera is exclusively intracellular in its action; there is a secretion, though a feeble one, of ferments in the gastrovascular cavity in many cases; in the Siphonophora digestion is, without doubt, exclusively intracellular.

Histology of Cœlentera.§—Dr. K. C. Schneider has been corroborating his conclusions as to cell-structure by a study of Cœlenterates. His method is to macerate with osmic and acetic acid, and to stain with carmine. The forms chiefly studied were *Forskalea contorta*, *Velella spirans*, *Carmarina hastata*, *Pennaria cavolini*, *Pilema pulmo*, *Pelagia noctiluca*, *Alcyonium acaule*, *Adamsia Rondeletii*, *Beroe ovata*.

Muscular structures may appear in any region of the cell; they may be basal, epithelial, or central, wholly or partially ensheathed in proto-

* Zool. Anzeig., xvi. (1893) pp. 76–8 (2 figs.).
† Comptes Rendus, cxvi. (1893) pp. 557–60.
‡ Bull. Ac. Roy. Belg., lxiii. (1893) pp. 262–6.
§ Jen. Zeitschr. f. Naturwiss., xxvii. (1893) pp. 379–462 (7 pls.).

plasm. They consist of elongated parallel elements ("Linen") united by a specific cement substance. Lateral twigs are absent. Cells or parts of cells or non-nucleated elements form supporting elements, which consist of cemented "Linen" with a parallel or more complex disposition. Nervous cells have not a characteristic framework; stimuli are believed to be transmitted by the interfilar substance. Glandular cells are characterized by the abundant presence of homogeneous substances between the "Linen." Stinging-cells are secretory cells in which a sudden emptying of secretion occurs through an apparatus formed from the framework. In indifferent cells the protoplasm is homogeneous.

The indifferent cell represents a primitive condition; it consists of a "Linar" framework—the mobile element—and of granula. Besides and between these lie the secretions, &c., of the granula. The granula consists of Zoa ("einfachste Lebenswesen"), and the "Linen" are Zoa united in rows. In muscle the "Linen" are elongated, isolated, and arranged in parallel rows, and the granula forms a cementing mass. In elastic structures the secretion of the granula makes contraction of the "Linen" impossible. In nerve-cells the granula forms a specialized interfilar substance. In glandular cells the framework is unimportant, the granula is actively secretory. In stinging-cells the granula has an intense activity, and the contractile outer wall of the capsule involves a complex arrangement of "Linen."

Structure of Anemonia sulcata Penn.*—Sig. Cazurro y Ruix has made an anatomical and a histological study of this sea-anemone. As far as we have been able to judge, his results are almost wholly confirmatory of those of the Hertwigs and others. The very rough woodcuts seem hardly worthy accompaniments of the author's careful study.

New Species of Madrepora.†—Mr. G. Brook gives diagnoses of forty new species of the genus *Madrepora* preliminary to the publication of his catalogue of species in the collection of the British Museum, which is to be published shortly. Many of the forms are from the Great Barrier Reef or from the Macclesfield Bank.

New Species of Drymonema.‡—Dr. G. Antipa describes *Drymonema Cordelio* sp. n. found by Prof. Haeckel in the Gulf of Smyrna. The genus, it will be remembered, belongs to the Cyaneidæ. In this species the umbrella is a flat disc; the velarium is very broad, with 144 marginal lobes and notches; there are 8 rhopalia in deep notches of the subumbrella about a fifth of the radius from the margin; 4 per-radial oval fringes, each with two "*Zipfel*" $1\frac{1}{2}$ times as long as a radius, lie connected in the interradial spaces; there are 8 subradial thick oral knobs; there are 144 marginal pockets (128 tentacular and 16 ocular); the tentacles are very long and numerous on the median zone of the subumbrella; the gonads are horse-shoe-shaped and hang down.

Medusa of Lake Tanganyika.§—Mr. R. T. Günther gives a preliminary account of the freshwater Medusa from this lake, specimens of

* Anal. Soc. Españ. Hist. Nat., xxi. (1893) pp. 306–79 (28 figs.).
† Ann. and Mag. Nat. Hist., x. (1892) pp. 451–65.
‡ Jenaische Zeitschr. f. Naturwiss., xxvii. (1893) pp. 337–43 (1 pl.).
§ Ann. and Mag. Nat. Hist., xi. (1893) pp. 269–75 (2 pls.).

which have been sent home by Mr. F. J. M. Moir. The largest specimen was 2·2 cm. in diameter, but more commonly the medusæ were from 1 to 1·8 cm. in diameter. The umbrella is characterized by its flattened shape; the central portion is much thickened, and has the form of a nearly hemispherical lens. The velum is sometimes well developed, sometimes not so conspicuous. The gastrovascular system differs from that of all other Medusæ hitherto observed in the relative size of its parts; the mouth and stomach are of so great a diameter—two-thirds that of the umbrella—that the lips of the mouth probably never completely close the stomach in the adult animal. Mr. G. C. Bourne has suggested to the author a possible explanation of this curious dilatation of the mouth and stomach. Any increase in the diameter of these parts would, obviously, involve a corresponding increase in the circumference of the manubrium; now this last is the bearer of the reproductive organs, so that the large size of the mouth would appear to be correlated with an enlargement of the area upon which the reproductive organs are developed.

As in *Limnocodium*, the tentacles are very numerous, and may exceed two hundred in number; in large examples the four primary perradial tentacles are hardly larger than the interradial or adradial; as the relative lengths of the tentacles in preserved specimens vary greatly, these organs have clearly a considerable power of contraction and extension. The lumen of these tentacles is lined by large, thin-walled, columnar endoderm cells, which are continuous with the endodermic lining of the ring-canal. The thread-cells are small and generally arranged in little wart-like groups.

The sense-organs vary greatly in number in each circle, and are arranged at irregular intervals; they have the form of egg-shaped bodies, are refringent, and are attached to one side of a capsule, the walls of which are lined by a flattened epithelium. These bodies are composed of numerous cells, the basal of which are granular or opaque, while the apical are quite clear. While they have a remarkably close resemblance to the corresponding structures in *Limnocodium*, they differ in structure from all other sense-organs hitherto described in Medusæ. In *Limnocnida*, as the author proposes to call this new genus, there is no tubular extension of the capsules into the adumbral ectoderm layer of the velum as there is in *Limnocodium*.

Some specimens have the outer wall of the manubrium quite smooth, and these were found to be males and females with the external wall covered with ova or spermatozoa in all stages of development. Other individuals had small swellings on the manubrium, which were found to be stages in bud-formation.

The author reserves for the present the discussion of the affinities and position of *Limnocnida tanganjicæ*, but he points out that if we take Haeckel's system we are beset with almost the same difficulties as presented themselves in the case of *Limnocodium*.

Porifera.

Embryology of Sponges.*—Prof. Yves Delage deals at some length with this subject. He finds that the progressive differentiation of the

* Arch. Zool. Expér. et Gén., x. (1892) pp. 345–72 (8 pls.).

elements of Sponges does not commence quite as in other Animals. Some cells exhibit a tendency to change in form, extend, and fuse into membranes; others manifest the remarkable property of giving out flagelliform processes or absorbing them to form them afresh. All come at last to form an organism in which we find a protecting membrane, gastric cavities, and intermediate sustaining tissues; the whole is, necessarily, more or less comparable to similar formations in other Animals; but this is sufficiently explained by the fact that there is a uniformity in the general conditions of the histogenesis and organogenesis of organisms; and there is no need to invoke a tendency to reproduce the form of a common ancestor. M. Delage does not agree with those who would associate Sponges with the Cœlentera; he believes, indeed, that they have from the first followed a line of development apart from, but side by side with the line of descent of the Cœlentera and the other Metazoa.

There is not that opposition between the solid larvæ of Siliceous or fibrous Sponges and the hollow larvæ of the *Sycandra*-type that has been admitted by all previous writers, and that has been supposed to affect the destiny of the corresponding cells of the two types. In the former, the ciliated cells, at the time of fixation, temporarily lose their flagella, bury themselves in the tissues, and, after vicissitudes which vary in different genera, they become grouped afresh, and acquire a flagellum and a collar. The cells which are immediately below those that are ciliated, or which take part in forming the surface at the naked pole, are carried outwards, when they form the epidermis; just as, in *Sycandra*, do the granular cells of the posterior pole. The species chiefly studied by the author were—*Spongilla fluviatilis*, *Esperella sordida*, *Reniera densa*, and *Aplysilla sulfurea*.

Metamorphosis of Esperia.*—Dr. O. Maas has studied the larval development of *Esperia lorenzi* O. S. When the larvæ leave the mother by the efferent canals they ascend to the surface, and always seek the side of the aquarium which is towards the light. They measure about 1 mm. in length by ·55–·65 mm. in breadth, and have a yellow to orange pigment, which is absent at the posterior pole, and apparently, but not really absent at the anterior pole. The histology of the larva is described. In the great majority the pole which in swimming is directed forward becomes the base by which the larva fixes itself. In fixing there is a characteristic arrangement of spicules, and the larva is flattened. Externally there is a broad amœboid margin of clear, flat cells forming a sort of network; internally there is the still round main mass of the larva; between the two lies a zone of tissue in process of transition. A remarkable inversion of layers follows:—the internal and inferior cells with small nuclei in the fixed stage are the same as the external elements of the free larva, and the upper external cells of the fixed stage are the internal and posterior cells of the free larva. There is often a creeping movement of the whole sponge as if it were a gigantic amœba. In the next stage we have the retraction of the amœboid margin, the formation of subdermal spaces, and the origin of the ciliated chambers from groups of small cells which formed the ciliated epithelium of the

* MT. Zool. Stat. Neapel, x. (1892) pp. 408–40 (2 pls.).

larva, and are turned inwards in the metamorphosis. The whole metamorphosis comprises four stages :—(1) The transition stage, with larval tissue in the middle, a broad amœboid margin, and transitional tissue between; (2) the flattened stage, with modified larval tissue turned towards the margin, which is now narrower (period an hour after fixing); (3) retraction of the amœboid margin and assumption of definite contour (1–2 days); (4) acquisition of final form, arrangement of spicules in strands, and formation of osculum (third day).

Development of Ephydatia from the Gemmules.*—Herr W. Zykoff placed gemmules of *Ephydatia Müllerí* Lieb k., which had been dry for almost two years, in an aquarium, and in fifteen days the embryos began to creep out. Each was a somewhat compact clump of amœboid cells, enclosing a mass of yolk-substance, but forming an external layer of flat ectoderm cells with pseudopodia. The young organism becomes a little plate, with the gemmule shell near its middle. By the second day spicules appear, and canals arise as clefts in the mesodermic parenchyma. These become lined by very flat endoderm cells. By the second or third day an osculum is formed, before there are any ciliated chambers, and it is suggested that this is formed almost mechanically by the pressure of the internal water. On the third day the number of parenchyma (mesoderm) cells increases; the yolk-substance decreases; the number of spicules increases, and they grow; the canals branch; and the ciliated chambers begin to appear, apparently as cavities within clumps of parenchyma-cells, which subsequently communicate with the cavities of the canals. The fact of most interest is, perhaps, the most general one that the original mesoderm elements differentiate into ectoderm and endoderm. But one cannot help doubting whether these names mean very much in such a case.

New Sponges from the Mediterranean.†—M. E. Topsent, who has been working at the rich Sponge-fauna of Banyuls, gives diagnoses of forty new species of Sponges; some of these are representatives of new genera, of which *Sanidastrella* is a Tetractinellid; and *Raphisia*, *Leptosia*, *Acheliderma*, *Hymerhabdia*, and *Holoxea* Monaxonids. The distribution of some Sponges is shown to be very wide.

Protozoa.

Infusoria in Sputum from Pulmonary Gangrene.‡—Dr. Streng has observed Infusoria in two cases of pulmonary gangrene. They were found in the yellow fœtid sputum, together with masses of bacteria. They are described as oval, apparently structureless cells about the size of white blood-corpuscles, endowed with very lively movements. At one end were several flagella, and the cells seemed able to alter their shape. On agar, gelatin, and blood-serum they did not increase, but in bouillon at incubation temperature they were present in large numbers for 4–5 days. By the tenth or eleventh day they were dead and gone.

The method suggested by Kannenberg for staining Infusoria with aqueous methyl-violet and examining in saturated acetate of potash was

* Biol. Centralbl., xii. (1892) pp. 713–6.

† Arch. Zool. Expér. et Gen , x. (1892) pp. xvii.–xxviii.

‡ Fortschr. d. Med., x. (1892) No. 19. See Centralbl. f. Bakteriol. u Parasitenk., xii. (1892) pp. 763–4.

not so successful as Lugol's solution, to which some alcoholic iodine solution had been added until it assumed a dark-brown tone. It would seem that this stains the flagella, which are not rendered evident by Kannenberg's method.

Several other cases of monads in pulmonary gangrene have been recorded, but there are also instances of their presence in pleural exudation unconnected with gangrene of the lung. Too much importance must therefore not be assigned to this otherwise interesting occurrence.

Infusorial Parasite of Freshwater Fish.*—Dr. O. Zacharias noted that in May 1892, fish kept in a large aquarium at Plön were affected with an infusorial parasite which on further examination turned out to be a species of *Ichthyophthirius*.

The epidermis of fish thus affected seemed, when looked at with a hand-lens, as if it were stippled all over with little white prominences. On every fish there were several hundreds of these tiny receivers, the result of cell-proliferation, and in each was located a large infusorium which often exhibited lively movements.

When viewed from above the parasite is of oval form (0·65–0·8 mm. long and 0·5–0·55 mm. broad). The upper surface is slightly arched and the lower quite flat. The whole surface is covered with cilia, and towards the front end is a large horse-shoe-shaped nucleus. With reflected light the animalcule is chalky white, with transmitted greyish yellow. Within its substance are numerous refracting granules and small crystals; the endoplasma is vacuolar in structure and contains numerous tiny hollows, but no contractile vesicle was observed. Towards the front of the ventral surface a depression (0·035 mm. deep) was noticed, but this was regarded rather as an organ of adhesion than as an oral aperture. On this account the author calls the parasite *Ichthyophthirius cryptostomus*.

The propagation of the parasite is effected in the simplest manner. It assumes a spherical shape and invests itself with a very delicate sheath, within which cyst it divides into two moieties and from each of these two others are produced; so that in a few hours, from one mother-individual 100–150 offspring are produced. These are spherical, with a diameter of 0·075 mm. In a comparatively short time the cyst is ruptured from the lively movements of the youthful parasites, which swim about to find themselves another resting-place on the back of a fish. In each young parasite, beside the macronucleus is a micronucleus, which latter disappears when the animal is a few hours old.

The parasite is very detrimental to the skin of the fish. This where affected is thrown off and thus becomes a ground for the settlement of all sorts of vegetable parasites, e. g. *Saprolegnia ferox*.

New Argentine Protozoa.†—Prof. J. Frenzel continues his description of new forms:—*Nuclearina Leuckarti* g. et sp. n., with one nucleus, one vacuole, rays which are never branched, and no gelatinous envelope; *Nuclearella variabilis* g. et sp. n., somewhat like *Nuclearia* Cienkowsky, but with one nucleus, and a sharp limitation of the membrane-like ectosarc from the endosarc; *Elæorhanis arenosa* sp. n.; *Lithosphærella compacta*

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 718-20.

† Bibliotheca Zool. (Leuckart and Chun), Heft xii. (1892) pp. 51-81 (2 pls.).

g. et sp. n., like *Lithocolla globosa* F. E. Sch., but without granules in the rays; *Estrella aureola* g. et sp. n., with numerous fine rays which are branched; *E. socialis* sp. n. like *Microgromia; Heliosphærium aster* g. et sp. n., like *Nuclearia*, having a thick gelatinous envelope, but spherical or almost spherical in form, with a single nucleus, and unbranched rays; *H. polyedricum* sp. n., with finer rays, central nucleus, and more angular form.

Pelomyxa palustris and other Low Organisms.*—M. E. Penard has a general account of *Pelomyxa palustris*, but does not present us with any new result. *P. Belevskii* is a new species, found in October, when *P. palustris* had almost disappeared; it differs by its much smaller size and less swollen body, and the presence not of stony particles but of vegetable fragments of all kinds. The presence of the refractive bodies characteristic of *P. palustris* has not been demonstrated in the new species, but this phenomenon may be seasonal. There are contained in it a number of parasites, but the green *Protococci* which are characteristic of every example of *P. palustris* are always wanting, and that though the two species are found in the same pond.

Other new forms described are *Difflugia mammillaris*, *D. elisa*, *D. urceolata* var. *lebes*, *Quadrula discoides*, *Nebela minor*, and *N. tenella*. The author has had the opportunity of investigating *Lesquereuxia jurassica* of Schlumberger, of which he describes a variety that he calls *epistomium*.

New Marine Rhizopod.† — Under the names of *Pontomyxa flava* M. E. Topsent describes a new form which may, at Banyuls, be frequently found on *Microcosmus Sabatieri*, where it forms yellowish spots. These do not remain compact, but form ramifications, the filaments of which are extremely fine, and frequently more than four or five centimetres long. As the organism has no envelope it is one of the Amœbæa, and its pseudopodia show that it belongs to the group Reticulosa. It is characterized by its colour, its large size, the complete absence of vacuoles in its mass, and, above all, by the large number of its nuclei. In organization it is extremely simple; there is a hyaline nucleated protoplasm and yellow granules; all the pseudopodia are contractile, and there is nothing comparable to the permanent and undivided filament of *Aletrium pyriforme*. The nuclei have a diameter of 50–60 μ, are perfectly spherical, and have a doubly contoured nuclear membrane; by their number and structure they call to mind those of *Pelomyxa*. This form takes, among the Reticulosa, a position comparable to that occupied by *Pelomyxa* among the Lobosa. Cysts have never been observed in it.

Microscopical Fauna of the Cretaceous in Minnesota. ‡— Messrs. A. Woodward and B. W. Thomas give a list, with detailed synonymies, of the Foraminifera found in this deposit; there is a short notice on Coccoliths and Rhabdoliths, and still briefer references to Radiolarians, Sponges, and Echinoderms.

* Arch. Sci. Phys. et Nat., xxix. (1893) pp. 165–84 (1 pl.).

† Arch. Zool. Expér. et Gén., x. (1892) pp. xxxi. and ii.

‡ 'The Microscopical Fauna of the Cretaceous in Minnesota, &c., Final Rep. of Geol. and Nat. Hist. Survey of Minnesota,' iii. (1893) pp. 23–54 (3 pls.).

Development of Gregarines of Marine Worms.* — M. L. Léger has made a study of the development of *Doliocystis nereidis*, which lives in the intestine of *Nereis cultrifera* and of *D. polydoræ* sp. n. from the intestine of *Polydora Agassizi*. During the budding stage the Gregarine always consists of two segments, but this dicystid stage does not last long; the young very soon lose their epimerite, and become free in the intestine, when they appear to be true Monocystids. The author finds that the development of these two species is identical with that of the genus *Schneideria*, the only difference being that, in these, the epimerite is always simple. Encystment and sporulation are on the polycystid type. The author proposes the new generic term *Doliocystis*, and regards the genus as peculiar to the digestive tube of marine Worms, while *Schneideria* is found in terrestrial Arthropods.

Hæmatozoa of Cold-blooded Vertebrates.†—M. A. Labbé states that, with the exception of the Flagellate Infusoria and *Cytamœba ranarum*, the Protozoa parasitic in the blood of cold-blooded vertebrates all belong to the genus *Drepanidium*, of which, at present, four species are known; at present they have not been detected in the blood of Fishes, though they probably exist there. A short account is given of *Drepanidium*, and it is suggested that a group should be formed for them, to be called Hémosporidiés [Hæmatosporidia].

Lower Organisms in Caterpillar Blood.‡— Dr. R. Hartig found *Cercomonas muscæ domesticæ* by millions in the blood of a healthy pine-moth caterpillar. These Flagellata do not appear to have been observed previously in caterpillars' blood. In caterpillars, pupæ, and imagines which had been attacked by Tachinæ and Ichneumonidæ, large numbers of a yeast-like fungus were found, and to this a malady of the caterpillar is to be ascribed. It is oval or lemon-like in shape, resembling *Saccharomyces apiculatus*, but is larger than it, being 6–8 μ in longitudinal diameter. Infection of living pine-moth caterpillars and cultivations did not succeed.

Protozoa in Mycosis fungoides.§ — Prof. R. Wernicke describes a protozoon which was found in a case of mycosis fungoides—a skin disease affecting the corium, and having histological appearances resembling, according to some observers, a granuloma tumour, and according to others sarcoma. In the author's specimen the tumours in the corium consisted of round cells with sometimes giant cells, having one or many nuclei. Within the giant cells were included bodies regarded by the author as Coccidia. They are round bodies, of a pale yellow colour, invested by a hyaline chitinous membrane. Their contents are granular, and no nucleus was demonstrable therein.

As many as ten of these bodies were observed in one giant cell, and they measured from 3 to 30 mm. The contents of the cysts, though usually granular, sometimes consist of definitely segmented

* Comptes Rendus, cxvi. (1892) pp. 204–6. † Op. cit., cxv. (1892) pp. 617–20.

‡ Forstlich-Naturwiss. Zeitschr., i. (1892) pp. 124–5. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 269.

§ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 859–61 (4 photomicrographs).

protoplasm (daughter-cysts), and these latter are set free by rupture of the investing membrane of the mother-cyst.

The parasites were present in enormous numbers, as many as 70 being counted in one field of the Microscope (Zeiss apo. 8 mm. oc. 4), and they could be seen without any special preparation whatever, though they were easily stainable by the anilin pigments, of which vesuvin-glycerin was the best.

Coccidiosis of Rabbits.*—Dr. R. Pfeiffer claims to be the first to have discovered the fact that the coccidia of rabbits multiply by means of "swarming cysts" as well as from spores and falciform germs. It is in young rabbits that proliferation by swarming cysts is the more common, and it consists in the direct fracture of many falciform bodies from a ripe coccidium, and this without being preceded by the development of a definite number of spores, each of which, in its turn, produces a definite number of falciform bodies.

The author portrays the "exogenous sporulation" of *Coccidium oviforme*, a phase well known from the researches of other authors. By this he understands a proliferation taking place outside the body of the host in which spore-formation occurs within cysts (L. Pfeiffer's resting-cysts). By "endogenous sporulation" is meant the same thing that L. Pfeiffer has called the "swarming cyst."

Experiments to prove the connection between the two forms of sporulation, by feeding young rabbits with ripe exogenous sporocysts, failed.

* 'Beiträge zur Protozoen-Forschung,' part i., Berlin, 1892, 24 pp., 12 photo-micrographs. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 733–5.

BOTANY.

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

a. Anatomy.

(1) Cell-structure and Protoplasm.

Nucleus and Formation of Membrane in Fungi and Myxomycetes.*—According to Herr F. Rosen there are three different ways in which division of the nucleus and cell-division may take place, unconnected with one another, viz.:—(1) Cell-division takes place independently of the nuclei, or at least of its divisions (*Cladophora*); (2) Division of the nucleus takes place without any following cell-division; and either (*a*) the cell no longer divides, while the number of nuclei increases, or (*b*) the multiplication of nuclei partakes of the character of a pathological phenomenon, or is the result of external forces. The last case, which is very common in the animal kingdom, has been observed in plants in parasitic infection, especially in the formation of galls; and in callus.

After detailing the observations which have been made on the mode of nuclear division in the Fungi and Myxomycetes, the author thus sums up the more important conclusions. In no case hitherto observed does the division of the nucleus in Fungi partake altogether of the character of indirect division; the process is, on the other hand, always simpler than in the higher plants. Only in *Trichia* and in the Exoasceæ has a typical achromatic figure been distinctly seen. The division of the chromatic elements or nuclear filaments is never effected by longitudinal fission. The simplification cannot be regarded as simply a result of the small size of the nuclei, since the greatest abnormalities have been observed in *Synchytrium Taraxaci*, where the nuclei are the largest. But, as a general rule, the smaller the nuclei, the more simple is their mode of division. In the smallest of all nothing can be detected but an appearance of chromatic granules, followed by a division into two groups which constitute new nuclei. In some Myxomycetes the nucleus takes part in the formation of membrane, not, however, in its first appearance, but in its further development. The author confirms the main points of Sachs's statement † with regard to the part played by energids in the vital processes within the cell.

Streaming of Protoplasm.‡—Herr P. Hauptfleisch distinguishes three kinds of movement of the protoplasm in cells invested with a cell-wall:—an irregular circulation in the meshes of the albuminous network, corresponding to the streaming of protoplasm in naked plasmodes; a rotation along the walls of the cell; and an oscillatory movement of the particles, resembling that known as the brownian movement. All these movements belong only to cells of a certain age, after vacuolation has commenced; in the movement of rotation all the organized elements

* Beitr. z. Biol. d. Pflanzen (Cohn), vi. (1892) pp. 237–66 (2 pls.).
† Cf. this Journal, 1892, p. 381.
‡ Jahrb. f. Wiss. Bot. (Pringsheim), xxiv. (1892) pp. 173–234.

of the cell—nucleus, chromatophores, crystals, &c.—are carried along in the current, the cell-sap of the peripheral portion also taking part in it. The author has determined that these movements are not always, as some have supposed, the result of lesion, though they are often provoked by external injury. A primary movement, independent of lesion, occurs in cells belonging to every conceivable kind of active tissue, and in all classes of plants. It commences with the sudden movement of separate particles of the protoplasm; currents are often set up in opposite directions with only a very narrow zone between them, the particles in the two currents frequently cannoning against one another, and then proceeding in their original direction.

Changes of external condition have a great effect in promoting the movement of the protoplasm, as e.g. the isolation of the cell, or placing it in an artificial medium, such as a 5 per cent. solution of sugar; it is affected greatly by changes of temperature, but not by light independent of temperature, nor by gravitation, nor by the electric current; chemical agents which have an injurious influence on the life of the cell also retard the circulation of the protoplasm. The presence of oxygen is, however, indispensable for it. The circulation in one cell is quite independent of that in adjoining cells, and there is never any mass-movement of the entire protoplasm of a cell. Although these movements are an evidence of the activity of the protoplasm, their intensity is by no means always in proportion to that activity.

Proteosomes.*—Herren O. Loew and T. Bokorny have further investigated the nature of these bodies produced in living cells by the action of coffein or antipyrin, and confirm their previous statement—in opposition to the view of Klemm—that they consist of active albumen. They occur in a great number of plants, in Algæ, and in stamens, young leaves, petals, epiderm, hairs, sometimes in either the cytoplasm only or in the cell-sap only, in *Spirogyra* and other organisms in both. Their albuminous nature is indisputable, as shown by their behaviour to Millon's reagent, their coagulation with boiling water, and in other ways, though they may enclose various other substances, such as tannin. They are very readily transformed into passive albumen. The authors re-state their conviction that living organisms contain groups of aldehyds.

In another paper, Dr. T. Bokorny † maintains, in opposition to Klemm, his previous statement that the proteosomes in the leaves of Crassulaceæ (*Echeveria*) are formed in the cytoplasm and not in the cell-sap. Their behaviour is precisely the same in *Echeveria* as in *Spirogyra*.

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

Formation of Starch.‡—M. J. C. Koningsberger has studied the mode of formation of starch in the Angiosperms, and points out a difference in this respect between Monocotyledons and Dicotyledons. Of the two modes of formation of starch-grains—directly from the protoplasm or through the intervention of amyloleucites or starch-generators—the latter is more common among Monocotyledons (12 out of 18 species

* Flora, lxxvi. (1892) Ergänzungsband, pp. 117–29; and Bot. Centralbl., liii. (1893) pp. 187–9. Cf. this Journal, 1892, p. 631.

† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 619–21.

‡ Arch. Néerl. Sci. Ex. et Nat., xxvi. (1893) pp. 217–58.

examined), the former among Dicotyledons (8 out of 12 species). From this the author concludes that the Monocotyledons are the older type. The chromatophore system exhibits a gradual advance in complexity in ascending from the lower to the higher types of vegetable life, attains its highest degree of development in the Monocotyledons, and then again declines in the Dicotyledons. In the true Algæ there are no leucoplasts. In the Chlorophyceæ there are chloroplasts, in the Phæophyceæ phæoplasts, in the Rhodophyceæ (Florideæ) rhodoplasts. In the Characeæ there are both chromoplasts and leucoplasts. The Muscineæ contain leucoplasts, but their function is of small importance. In the Vascular Cryptogams and Gymnosperms the structure attains a higher development, though not equal to that of the Angiosperms. In many Dicotyledons the leucoplasts have again entirely disappeared. The first formation of a grain of starch is probably due to a deposit of amylodextrin. The property of polymerizing carbo-hydrates of a low molecular weight probably resided at first in the leucoplasts, although in many of the higher plants it has passed to the protoplasm.

Morphology and Formation of Starch-grains.*—Herr A. Binz has followed out the mode of formation and the structure of starch-grains, especially in *Pellionia Daveauana*. The grains are composed of an enormous number of layers, some more and some less dense, of which the latter are by far the most numerous. The author states that his observations contradict Nägeli's theory that the layers are formed by the splitting of layers previously in existence. The outer layers are always the youngest, and the inner ones the oldest. These facts strongly corroborate the theory of apposition. The chloroplast consists of a homogeneous matrix or stroma, with imbedded pigment-granules or grana. The starch-generators are present in the growing points as leucoplasts; they are structures homologous to the chloroplasts, into which they are directly transformed under the influence of light. They multiply by simple division. Compound starch-grains are formed in two ways—either several grains are formed in a single starch-generator (epiderm of *Philodendron*, *Pellionia*, *Symphytum tuberosum*, *Convallaria*, *Odontoglossum*, *Epipactis palustris*), or several starch-generators unite into groups (pith of *Philodendron*, *Convallaria*, *Stanhopea*).

Localization of the Fatty Oils in the Germination of Seeds.†—M. E. Mesnard states that in a large number of cases examined by him (excluding grasses), the fatty oils are not localized in the germination of the seeds; they behave like the albuminoids which they ordinarily accompany. In grasses (wheat, rye, barley, maize), during the period of repose, these oils are found only in the scutellum and in the embryo; subsequently starch makes its appearance in the scutellum, and, together with the oils and the albuminoids, passes into the growing embryo.

Iron-greening Tannins.‡—Mr. S. Le M. Moore, by the use of Millon's reagent, obtains further confirmation of his view that the substance in certain cell-walls which causes them to give several of the

* Flora, lxxvi. (1892) Ergänzungsband, pp. 34–91 (3 pls.). Cf. this Journal, 1892, p. 497.

† Comptes Rendus, cxvi. (1893) pp. 111–4.

‡ Journ. of Bot., xxxi. (1893) pp. 52–3. Cf. this Journal, 1892, p. 630.

reactions whereby proteids are recognized, is not protein, but an iron-greening tannin. A number of instances are given where the reaction succeeded, in xylem, hard bast, meristem, &c.

(3) Structure of Tissues.

Tannin-apparatus of the Leguminosæ.*—Dr. P. Baccarini has studied the structure and distribution of the tannin receptacles in a large number of Leguminosæ belonging to all the three sub-orders. They are not found in the whole of the order, the Podalirieæ, Genisteæ, Trifolieæ, and a portion of the Galegeæ being destitute of them. The distribution of the receptacles is very various in the different tribes and genera; the original type may be regarded as that of *Ceratonia siliqua* and *Cercis siliquastrum*, where they are localized in the epiderm. In another type they are hypodermal, and in a third they are immersed in the cortex. In those species where there is a tannin-apparatus belonging to the vascular bundles, it is usually situated in the outer portion of the bundle.

The tannin or tannins are accompanied by abundance of an albuminoid substance, and they are by no means confined to these special receptacles. The receptacles are especially well developed in the Loteæ, Galegeæ, Phaseoleæ, and many Hedysareæ; and in these tribes there is a clear distinction between an extrafascicular tannin-system and one belonging to the vascular bundles (parafascicular); one only or both systems may occur in the same species. The tanniferous cells are characterized by the presence of threads of protoplasm connecting them with one another and with the elements of other systems of a different histological character.

Secretory System of Copaifera.†—M. L. Guignard describes in detail the system of secretory passages in *C. officinalis* and other species of *Copaifera*. The structures in which the balsam is formed are found in the stem, leaves, and root, but they differ somewhat in the different organs. The reservoirs are always of schizogenous origin; they make their appearance in the meristem at an early period. They attain their fullest development in the xylem of the stem, where the canals anastomose into an irregular network. The system differs from ordinary secreting canals in the appearance and mode of formation of the border-cells. These are not the result of repeated radial divisions of the cells which originally surround the cavity, and do not form a distinct layer, as is usually the case. They are derived from cambium-cells, the number of which varies, but scarcely increases during the formation of the cavity. In the root there is at first a single long central cavity in the pith; the number of these subsequently increases, but they remain isolated, while anastomosing canals appear in the xylem. In the stem the canals of the pith and of the cortex also remain permanently distinct, while those of the xylem anastomose abundantly, and usually form a circle in the inner part of each zone of growth. In the leaves there is a large secreting gland in each mesh formed in the parenchyme by the finest veins.

* Malpighia, vi. (1893) pp. 255-92, 325-56, 537-63 (6 pls.).

† Bull. Soc. Bot. France, xxxix. (1892) pp. 233-60 (13 figs.); and Comptes Rendus, cxv. (1892) pp. 673-5.

Suberous Layer and Suberin.*—M. C. van Wisselingh gives the result of a series of chemical experiments on the nature of the corky layer in trees, those especially examined being *Quercus suber*, *Cytisus Laburnum*, *Virgilia lutea*, *Ilex Aquifolium*, *Betula alba*, *Pyrus Malus*, and *Salix caprea*. The existence of cellulose in the corky layer was disproved, no indication could be discovered of the occurrence of this substance between the middle lamella and the cellulose-wall, which is generally more or less lignified. The corpuscles described by Wiesner under the name of dermatosomes are united with one another, not by protoplasm, but by a totally different substance. The number of substances which produce cork is probably much larger than is generally supposed.

Mucilage-threads in the Intercellular Spaces of the Roots of Orchideæ.†—In the intercellular system of the roots of several species of *Epipactis* and *Cephalanthera*, Herr F. Noack finds branched or moniliform threads or "tendrils" of mucilage springing from the cell-walls, which might easily be mistaken for the mycele of a parasitic fungus. Similar structures have been found in the spongy parenchyme of the leaves in Marattiaceæ, and in the spongy parenchyme of the aerial roots of *Phœnix spinosa*. In the Orchideæ they occur only in the cortical parenchyme of the roots; and their distribution in the intercellular spaces is very irregular. The chemical reactions show that they do not consist of cellulose. The mucilage appears to be not a secretion of the cell, but the result of local transformation of the layer of cellulose which lies immediately beneath the central lamella.

Mucilage Receptacles of Hypoxideæ.‡—Sig. R. Pirotta finds, in *Hypoxis* and other allied genera, receptacles for mucilage which have not hitherto been noticed. They occur in the rhizome and in the leaf-stalk or leaf-sheath, but not in the root nor in the floral region, nor in the lamina of the leaves. The author regards their presence as a useful character for distinguishing the Hypoxideæ from the Amaryllidaceæ.

[(4) Structure of Organs.

Colouring-matter of Pollen.§—According to MM. G. Bertrand and G. Poirault, the colour of dry pollen-grains (Urticaceæ, Gramineæ, &c.) is due to the cutinization of their outer membrane, while that of moist grains is derived from the carotin contained in the oily matter which covers the surface of the grains. This oil is coloured an indigo-blue by sulphuric acid; and the authors give the details of micro-chemical experiments by which they identified its colouring substance with the carotin which is widely distributed through the vegetable kingdom. They suggest that the purpose served by the carotin may be the powerful odour which accompanies its oxidation, and which may attract the visiting insects. The plant experimented on was *Verbascum thapsiforme*.

* Arch. Néerl. Sci. Ex. et Nat., xxvi. (1893) pp. 305–53.
† Ber. Deutsch. Bot. Gesell., x. (1893) pp. 645–52 (1 pl.)
‡ Atti R. Accad. Lincei, i. (1892) pp. 376–8.
§ Comptes Rendus, cxv. (1892) pp. 828–30.

Extra-floral Nectaries.*—Herr S. Aufrecht has studied the structure and development of extra-floral nectaries, especially in *Ricinus communis*, *Impatiens glandulifera*, *Viburnum Opulus*, *Passiflora cærulea*, and *Acacia lophantha*. In *Ricinus* and *Passiflora* the secreting epiderm consists of two, in the other examples of only a single layer of cells. In *Ricinus*, not only the epidermal cells, but also those of a hypodermal layer, and of still lower regions of the cortical tissue, take part in the formation. In all cases the cells contain a finely granulated, nucleated, colourless or pale yellow protoplasm. There is always a strongly developed vascular system, consisting either only of spiral or also of other kinds of vessels, ending immediately beneath the glandular tissue. The secretion escapes, in *Ricinus* and *Passiflora*, by rupture of the cuticle, in *Impatiens* through the cuticle, in *Viburnum* through stomates, in *Acacia* through slender pore-canals. Only in *Acacia* were trichomic structures observed on the secreting surface. In *Acacia* no secretion of nectar could be detected; in the other instances it consists of a sugar which does not reduce copper oxide in the cold. No starch was observed in the nectary-tissue. Tannin always occurs in large quantities, usually accompanied by anthocyan; also calcium oxalate in various forms. The function of this latter is to serve as a conveyor of the carbohydrates. The anthocyan plays the part of attracting noxious insects away from the flower; while the tannin protects the nectaries from injury by insects, especially ants.

Seeds of the Ampelideæ.†—Prof. A. N. Berlese has studied the form, structure, and development of the seed in various species of Ampelideæ belonging to the genera *Vitis*, *Ampelopsis*, *Cissus*, *Tetrastigma*, and others. The following are the more general results obtained.

The ovary is bilocular, and has originally four ovules, of which three are usually abortive. The embryo-sac originates from the third cell of the axile row resulting from the development and division of the hypodermal mother-cell. There are two antipodals and two synergids; the former have a very short existence. During the development of the embryo-sac two caps (calottes) are formed; the inner one soon disappears entirely, while traces of the outer one remain for a considerable time near the micropyle. The ovule, at first orthotropous, becomes rapidly anatropous. It has two integuments, which persist in the ripe seed; the outer one is always composed of three layers. The suspensor remains attached to the embryo till its maturity; the plumule is rudimentary; the embryo is straight; the cotyledons are opposite and curved. The greater part of the endosperm remains in the mature seed; it is oily, rarely farinaceous, and contains large aleurone-grains; each aleurone-grain encloses a crystal of calcium oxalate isolated or enclosed in a globoid, and sometimes also a crystalloid.

Embryo of Palms.‡—M. H. Micheels describes the form of the embryo in a number of different species of palm, which is subject to considerable variation. The form is usually that of a cone (or some form derived from the cone), compressed or not, more or less rounded or

* 'Beitr. z. Kenntniss extrafloraler Nectarien,' Zürich, 1891, 44 pp. See Bot. Centralbl., 1892, Beih., p. 441.

† Malpighia, vi. (1893) pp. 293–324, 482–536 (2 pls.).

‡ Bull. Soc. Roy. Bot. Belgique, xxxi. (1892) pp. 174–8.

dilated at the summit, flat, concave, or convex at the discoid base, with or without a central projection, and separated or not from the cotyledon by a groove.

Embryo of Grasses.*—Dr. E. Bruns describes the structure of the embryo of a number of grasses, especially in reference to the presence or absence of the epiblast, a sheathing structure frequently found in connection with the lower part of the scutellum; he regards it as being, like the scutellum, a reduced leaf or cotyledon, but destitute of a vascular bundle. The presence or absence of the epiblast is not uniformly even a tribal characteristic. It was absent in all species examined of the Maïdeæ and Andropogoneæ, and present in all those examined of the Oryzeæ, Agrostideæ, and Aveneæ; but in the Paniceæ, Phalarideæ, Festuceæ, and Hordeæ, there are genera with and genera without, and in the genus *Brachypodium* even species with and species without an epiblast.

Embryo of Petrosavia.†—Mr. P. Groom has examined the structure of the embryo of this genus of parasitic Liliaceous plants from the East Indies. He finds it to be of excessively simple structure, consisting of a very small number of cells, in never more than two layers, and with scarcely any differentiation.

Phyllotaxy.‡—After discussing the various theories that have been propounded to account for the different varieties of phyllotaxy, Herr K. Schumann points out that the arrangement of leaves in straight or spiral lines is intimately connected with the symmetrical or unsymmetrical development of the sheathing bases of the leaves, which make their appearance upon the growing point of the plant before the leaves do. This is the case in all Monocotyledons and in most Dicotyledons. This view is supported by a description of the phenomena in *Adoxa* and in the cohort Fluviales.

Leaves of Alpine Plants.§—Herr A. Wagner has investigated the structure of the leaves of a number of alpine plants (Dicotyledons) with reference to their adaptations to the conditions of climate, especially to the necessity of an increased activity of assimilation required by the greater intensity of the light, the short period of vegetation, and the reduced amount of carbon dioxide in the atmosphere. He finds these adaptations provided for by the increase in length or in number of the palisade-cells, by the looser structure of the mesophyll, by the very frequent occurrence of numerous stomates on the upper surface, and by the usually exposed position of the guard-cells. The leaves do not in general exhibit any provisions against excessive transpiration; this is shown by the loose structure of the mesophyll, the absence of a strongly thickened epiderm, the exposure of the stomates, and the absence of any aquiferous tissue. These precautions are rendered needless by the great moisture both of the air and of the soil. They occur to the largest

* Flora, lxxvi. (1892) Ergänzungsband, pp. 1–33 (4 pls.).

† Ann. Bot., vi. (1892) pp. 380–2 (1 fig.).

‡ 'Morphologische Studien,' 1ste Abtheil., Leipzig, 1892, 206 pp. and 6 pls. See Amer. Journ. of Sci., xlv. (1893) p. 167.

§ SB. K. Akad. Wiss. Wien, ci. (1892) pp. 487–518 (2 pls.).

extent in evergreen alpine plants. The structure of the mesophyll is governed rather by the conditions of assimilation than of transpiration. A few cæspitose alpine plants display a strong development of the mechanical system.

Leaves developed in the Sun and in the Shade.*—M. L. Géneau de Lamarlière has carried on a series of experiments on the difference in leaves produced in the sun and in the shade, other conditions of soil, light, moisture, &c., being the same. The plants operated upon were *Mirabilis Jalapa*, *Berberis vulgaris*, *Weigelia rosea*, *Salix rosmarinifolia*, *Quercus pedunculata*, *Fagus sylvatica*, *Taxus baccata*. As a summary of the results, it is stated that all the vital functions are carried on more energetically in those leaves which are produced in the sun. They transpire more abundantly than those produced in the shade, and contain relatively less water; but the circulation is more rapid, and they receive a larger quantity of nutritive substances which are elaborated in the leaves. They are thicker, and carry on a more active respiration; and, since they contain a larger quantity of chlorophyll, their assimilation is also more active, and they fix a larger quantity of carbon.

Lianes.†—Herr H. Schenck gives a detailed description of the anatomy of lianes, and of the contrivances which assist them in climbing, especially those of Brazil. He classifies them under four groups:—(1) Those which climb by means of sensitive and nutating tendrils (Cucurbitaceæ, Passifloraceæ, &c.); (2) climbing plants (including *Lygodium*); (3) root-climbers (ivy); (4) spreading-climbers (*Spreizklimmer*), with long spreading branches, often provided with thorns or prickles, such as some palms. Of these, the first group, which are much the most highly developed, are treated in the greatest detail. The sensitive climbing organs may be either caulomes or phyllomes. In the latter either the blade, the apex, or the pedicel of the leaf may be adapted for climbing purposes. The former are again classified under several subdivisions, according to the morphological character of the axial climbing organ. A large number of illustrations are given of climbing plants belonging to each group, all those in any natural order being found, as a rule, in the same group. The anatomical structure of the climbing organ, as well as the physiological details, are minutely described.

Flora of the Indo-malayan Coasts.‡—Herr A. F. W. Schimper classifies the Indo-malayan marine flora under four heads, viz.:—(1) The mangrove, (2) the *Nipa*, (3) the *Barringtonia*, and (4) the *Pescapræ* formation. The mangrove formation consists of species of Rhizophoraceæ belonging to the genera *Rhizophora*, *Ceriops*, *Kandelia*, and *Bruguiera*; also of *Carapa moluccensis*, *Lumnitzera coccinea*, *Ægiceras majus*, *Avicennia tomentosa* and *officinalis*, and *Acanthus ilicifolius*. It is characterized by horizontal roots, often of enormous length, which often put out prop-roots serving to fix the tree in the very soft soil. The *Nipa*

* Rev. Gén. de Bot. (Bonnier), iv. (1892) pp. 481–96, 529–44 (1 pl.). Cf. this Journal, 1892, p. 823.

† 'Beitr. z. Biol. u. Anat. d. Lianen,' Jena, 1892, xv. and 253 pp. and 7 pls. See Bot. Centralbl., liii. (1892) p. 253.

‡ 'Die Indo-malayische Strandflora,' Jena, 1891, 204 pp., 7 pls., 7 figs., and 1 map. See Bot. Centralbl., liii. (1893) p. 53.

formation occurs in less salt lagoons and bogs which are only reached by the highest floods. The characteristic species is *Nipa fruticans*. The *Barringtonia* formation, consisting chiefly of species of that genus of Myrtaceæ, is characteristic of more sloping coasts. The *Pescapræ* formation, represented characteristically by *Ipomæa pes-capræ*, constitutes the sparse flora of the sand-dunes.

A marked feature of all these plants is the facility with which they absorb and store up chlorides in their tissues; this is especially characteristic of certain herbaceous orders, such as Plumbaginaceæ, Chenopodiaceæ, and Frankeniaceæ. Protection is further provided against excessive transpiration by the smaller surface and greater thickness of the leaves.

Inversion of Organs or Tissues.*—Dr. M. T. Masters describes a number of cases in which organs or elements of tissue exhibit a position inverse to that which they normally occupy, viz.:—Reversed position of the xylem and phloem-elements (fruit-scales of Coniferæ, where the relative positions of the xylem and phloem are the reverse of that found in the bracts); palisade cells (leaves of *Picea ajanensis*, where the palisade cells are on the dorsal or under, the stomates on the ventral or upper surface); stomates (adult leaves of juniper and *Picea ajanensis*, cladodes of *Ruscus androgynus*); the flower (abnormally in *Cypripedium*, *Gladiolus*, and barley); carpels (abnormally in *Citrus*, *Cratægus*, *Prunus*, &c.); gills of fungi (not unfrequent in species of *Agaricus*, especially the mushroom).

Structure of Witch-broom.†—Herr T. Hartmann describes the anatomical structure of the witch-broom of the silver fir. The following are the chief points of difference from the normal structure of the leaves and branches. The leaves have fewer stomates and a thinner cuticle; the resin-passages are smaller; the parenchyme-cells contain less starch and chlorophyll, and there are fewer cells with bordered pits. In the diseased branches the periderm is less strongly, and the cortical parenchyme more strongly developed; there is a much larger quantity of pith; the annual rings are less strongly developed.

β. Physiology.

(1) Reproduction and Embryology.

Embryo-sac of Aster and Solidago.‡—Mr. G. W. Martin has traced out the development of the flower, and especially that of the embryo-sac, in these two genera. The calyx appears second in order of succession of the floral whorls. The syngenesious anthers are united structurally in their origin. The ovule does not arise from the bottom of the ovarian cavity, but a little above the lowest point; it is, therefore, not a direct outgrowth of the axis, but an outgrowth of the leaf. In its early development the nucellus is almost orthotropous, and gradually becomes anatropous by greater growth on one side. The embryo-sac consists

* Journ. of Bot., xxxi. (1893) pp. 35–40 (5 figs.).

† 'Anatom. Vergleich. d. Hexenbesen d. Weisstanne u.s.w.,' Freiburg i. B., 1892, 39 pp. and 1 pl. See Bot. Centralbl., 1893, Beih., p. 60.

‡ Bot. Gazette, xvii. (1892) pp. 353–7, 406–11 (2 pls.); and Amer. Natural., xxvi. (1892) pp. 954–7.

at first of a single nucleated cell, which divides into four, but three of these disappear.

The author gives the following as the main differences between his own observations and those of Strasburger on *Senecio*. The antipodal cells occur in no regular order, and were never found arranged in a single longitudinal row. No more than four antipodal cells could be discovered, always naked and unseptated. The oosphere does not occupy the whole diameter of the embryo-sac. The nuclei of the cells composing the egg-apparatus seemed always to occupy a nearly central position. Vacuoles were seldom seen in the synergids.

Proterandry and Proterogyny.*—Mr. T. Meehan explains the phenomenon of dichogamy as the result of the law that stamens are called into active growth under a much lower or less enduring warm temperature than pistils. Of the two nearly allied species *Barbarea vulgaris* and *B. præcox*, the former is proterogynous, the latter proterandrous. The former flowers regularly about the first week in May (in Pennsylvania), the latter is very variable in its time of flowering, according to the season, and has probably acquired the proterandrous condition from occasionally flowering very early. *B. vulgaris* appears also to be habitually cross-pollinated by honey-bees, while *B. præcox* is certainly usually self-pollinated.

Pistillody of Male Catkins of Hazel.†—Herr L. Wehrli describes a case in which all the male catkins on a hazel-bush were converted into catkins of female flowers. Morphologically the flowers resembled the male rather than the female flowers, except in the substitution of female for male organs. They contained no ovules. The peculiarity was constant in successive years.

An example of hermaphrodite flowers on the hazel is also recorded by Mr. C. A. Newdigate.‡

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

Distribution of the Seed in Claytonia.§—Mr. J. C. Willis describes the mode by which the ripe seeds of *Claytonia alsinoides* are ejected from the capsule. They are pressed tightly against one another by the sides of the valves of the capsule moving inwards as they become dry after dehiscence, and are then forced out violently in succession by the continued pressure.

Exotrophy.‖—Prof. J. Wiesner gives examples of the law termed by him *exotrophy*, by which the organ on a lateral shoot which is on the opposite side to the mother-shoot is most strongly developed. In many cases anisophylly is entirely due to exotrophy, and is altogether independent of geotropism. The phenomenon is very frequently displayed in flower- or fruit-bearing shoots, e. g. the umbels of many Umbelliferæ (*Heracleum Sphondylium*), the cymes of *Sambucus nigra*, the

* Proc. Acad. Nat. Sci. Philadelphia, 1892, pp. 169–71.
† Flora, lxxvi. (1892) Ergänzungsband, pp. 245–64 (3 figs.).
‡ Journ. of Bot., xxxi. (1893) p. 153.
§ Ann. Bot., vi. (1892) pp. 382–3 (3 figs.).
‖ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 552–61 (2 figs.). Cf. this Journal, *ante*, p. 66.

spikes of *Trifolium repens*, *Iberis amara*, &c. It is due in the first place to a more copious nutrition on the side which becomes the most strongly developed.

Unequal Growth in Thickness resulting from position.*—Pursuing his researches on epitrophy and hypotrophy, Prof. J. Wiesner arrives at the general conclusion that heterotrophy is a compound phenomenon resulting from the position of the shoot, not only in reference to the horizon, but also in reference to its mother-shoot. With regard to whether the heterotrophy is exotrophic or endotrophic, a difference is manifested in a general way between Gymnosperms and Angiosperms. In most conifers, e. g. the yew, exotrophy is more common; with most Angiosperms, e. g. the lime, endotrophy is the more usual phenomenon.

Action of the Ultra-violet Rays on the Formation of Flowers.†—By observing the action on plants of light which has passed through a solution of sulphate of chinine, M. C. de Candolle arrives at the conclusion that, while the ultra-violet rays have the effect of greatly stimulating the formation of flowers, they are not essential to their development. The experiments were made chiefly on *Tropæolum majus;* less satisfactory results were obtained with *Lobelia Erinus.*

Torsions in the Growth of Leaves and Flowers.‡—Herren S. Schwendener and G. Krabbe have investigated the causes of the occurrence of these torsions (Orientirungstorsionen), in contrast to hygroscopic torsions, in leaves and flowers. They are always the result of external forces acting in a specific direction; internal forces can only cause curvatures. Those torsions which are caused by gravitation are termed by the authors *geotortism*, to distinguish them from true geotropism; while those caused by the action of light are called *heliotortism*, as contrasted with true heliotropism. Of the latter we have frequent illustrations in the stalks of zygomorphic flowers.

Dr. F. Noll § adduces arguments in opposition to Schwendener and Krabbe's theory of geotortism, and also to Frank's theory of a polarity in cells. He maintains his former contention ‖ that active movements, such as those which arise from geotropism, lead to the normal position of dorsiventral flowers. As in dorsiventral organs generally, the irritation of gravity acts on zygomorphic flowers, so long as they are not in their normal position, so as to bring the dorsal side again uppermost. The theory of geotortism does not in any way explain this phenomenon. Gravity and exotrophy are concurrent factors in the movements under consideration. Flowers which have shifted from their normal position with respect to the perpendicular by exotrophic movements must be restored to it by continuously repeated geotropic movements.

Secondary Increase in Thickness of Trees.¶ — Herr L. Jost finds that the increase in thickness of the branches of trees is, like their

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 605-10 (2 figs.).

† Arch. Sci. Phys. et Nat., xxviii. (1892) pp. 265-7.

‡ Abhandl. Akad. Wiss. Berlin, 1892, 165 pp. and 3 pls. See Bot. Centralbl., lii. (1892) p. 96. § Flora, lxxvi. (1892), Ergänzungsband, pp. 265-89.

‖ Cf. this Journal, 1891, p. 490.

¶ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 587–605 (1 fig.). Cf. this Journal, *ante*, p. 67.

increase in length, subject to a periodicity. With only a few exceptions in the trees observed, the growth in thickness exhibited two maxima and minima in each season; but in the different examples, these maxima and minima occurred at very different periods of the year. No necessary connection could however be established between the period of this growth in thickness and the period of the development of the leaves in each particular species, although the period of the commencement of the formation of the wood coincides with that of the unfolding of the leaves.

Development of Potato-tubers.*—M. A. Prunet refers to the well-known fact that the buds towards the summit of the tubers of the potato (anterior portion) develope more rapidly than those near the base (posterior portion). He finds the anterior portion of the tuber to be richer, as a general rule, in dry substance, in carbohydrates, in nitrogenous substances, in organic acids, and in salts, in particular, in potassa, magnesia, and phosphoric acid. Furthermore, he finds—in opposition to the view of Wortmann†—that the transformation of nutritive substances is effected, not by the direct action of the protoplasm, but by a diastase. At an early period the nutritive substances are equally distributed throughout the whole of the tuber; and it is only when it has attained its full size that a transport takes place in the interior of the tissue towards the buds in the anterior portion.

Stem-pressure.‡—Dr. J. Böhm states that he finds every year in stems (of the horse-chestnut) a very high positive pressure, sometimes amounting to nine atmospheres; while in the autumn there is a negative pressure, which usually attains its minimum in August or September. The great positive pressure appears to be due to osmose. The osmotic substances are the soluble constituents of the secretion formed during the production of the duramen.

Transmissibility of Pressure in Plants.§—M. G. Bonnier states that pressure is transmitted rapidly across the conducting tissues of woody plants. In herbaceous plants this does not take place immediately, and the transmission of pressure is much more feeble than in woody plants. In succulent plants the transmission is very slow.

Ascent of Sap.‖—Prof. S. Schwendener sums up the results of recent observations on this subject, and criticizes unfavourably the conclusions of Strasburger and Wieler on several points. In opposition to their view he contends that the ascent takes place in the older annual rings as well as in the peripheral portion of the alburnum, and that the libriform tissue may, in certain circumstances, play an important part in the phenomenon. He maintains that the bordered pits afford a large filtration surface for the sap to pass through. The phenomena of the conduction of sap cannot, in his view, be explained without the

* Comptes Rendus, cxv. (1892) pp. 751-2; and Rev. Gén. de Bot. (Bonnier), v. (1893) pp. 49-64.

† Cf. this Journal, 1891, p. 221.

‡ Ber. Deutsch. Bot. Gesell., x. (1892) pp. 539-44.

§ Comptes Rendus, cxv. (1892) pp. 1097-1100; and Rev. Gén. de Bot. (Bonnier), v. (1893) pp. 12-28, 74-83, 100-13 (2 pls. and 10 figs.).

‖ SB. K. Akad. Wiss. Berlin, xliv. (1892) pp. 911-46 (1 fig.). Cf. this Journal, 1892, p. 811.

co-operation of living cells. The ascent of sap to a height of 150 or 200 feet from the root-hairs is not explicable as a purely physical phenomenon.

Nutrition of Pines by Mycorhiza.*—Herr B. Frank records the results of a series of experiments on the growth of *Pinus excelsa* with and without mycorhiza. Of 12 seedlings sown in pots and grown in the open air, 4 were left unsterilized, while the soil in the other 8 was sterilized in the ordinary way. During the first year the growth of the 12 seedlings was nearly uniform; but in the second year those in the unsterilized pots all showed a decidedly more vigorous growth, which was much more strongly displayed in the third year; and in all these 4 plants the root was thickly covered with a mycorhiza-felt. In the 8 sterilized pots, with one exception, the root-system was much more feebly developed, there was no mycorhiza, and the size of the seedlings was much less. One of the 8 showed a better growth, and there was a certain amount of mycorhiza on the roots. Herr Frank concludes from these facts that the seedlings depend largely for their nutrition on the mycorhiza-fungus, and that it belongs to one or more species the spores of which are not present in the air in great abundance.

Adaptation of the Root to vital conditions.†—By experiments on cultivated plants—bean and oat—Herr C. Kraus demonstrated the power of the root to adapt itself to the conditions of the soil in which it grows, especially in the feebler development of the tap-root, and the stronger development of horizontal roots in a shallow layer of rich soil. The main purpose of the tap-root appears to be a mechanical rather than a nutritive one.

Water Culture of Plants.‡—Prof. J. Wortmann recommends large glass cylinders for the cultivation of plants in water, instead of the ordinary method. He finds, especially in cultures on this mode, that the root-system attains a remarkable development, resembling that of plants grown in the soil.

Influence of Moisture on Vegetation.§—From experiments on the cultivation of a number of plants, M. E. Gain draws the conclusion that the moisture of the soil and that of the air have very different effects on vegetation. The observations were made chiefly on the influence of different conditions of moisture on the flowering of the plants. The general result was that a moist soil is favourable, a dry air very favourable; while a dry soil is unfavourable, a moist air very unfavourable, to flowering.

Effects of Freezing on Absorption and Evaporation.‖—From experiments on a variety of plants (vine, bean, peach, pear, &c.), M. A. Prunet finds that, when branches have been frozen and again thawed, the evaporation from them is at first excessive, while at the same time the absorption of water is reduced much below the normal. The phenomenon of transpiration is converted into one of simple evaporation.

* Ber. Deutsch. Bot. Gesell., x. (1893) pp. 577–83 (1 pl.).

† Forsch. a. d. Geb. d. Agriculturphysik, xv. pp. 234–86. See Bot. Centralbl., lii. (1892) p. 312.

‡ Bot. Ztg., l. (1892) pp. 640–6 (3 figs.).

§ Comptes Rendus, cxv. (1892) pp. 890–2.

‖ Tom. cit., pp. 964–6.

Fixation of Free Nitrogen by Plants. — From experiments made on the oat, potato, colza, and grasses, MM. T. Schlœsing and E. Laurent* conclude that, under the conditions employed, these plants have no appreciable power of fixing free nitrogen.

On the other hand, as the result of experiments made on growing cress in river-sand watered by non-nitrogenous salts, Herr E. Bréal† claims to have demonstrated the fixation of atmospheric nitrogen by the seedlings. The seeds of plants grown in this way were, however, lighter, and contained less nitrogenous matter, than those grown in ordinary soil.

Herr A. Petermann‡ again confirms his earlier results that not only haricots, but also barley shows a gain of nitrogen, which must have been acquired directly from the air.

Absorption of Atmospheric Nitrogen by Microbes.§—M. Berthelot has experimented on the power of low organisms to absorb nitrogen from the atmosphere. Both natural and artificial humic acid were placed in a flask with water containing a small quantity of the lower forms of vegetation which had developed in the presence of light. The flasks were then carefully stoppered, and exposed to diffused light for several months. While microscopic growths of many species developed under these circumstances, a certain amount of carbon dioxide was formed, and there was an appreciable increase in the amount of combined nitrogen.

Influence of Anæsthetics on Transpiration.‖—The following are the general results of a series of experiments made by Mr. A. Schneider on the influence of ether on transpiration in a number of plants. Ether retards protoplasmic action, and, in sufficient doses, kills the protoplasm. It retards assimilation, and, in this way, retards transpiration under all conditions. The increased loss of water in an anæsthetized vegetable tissue is not due to transpiration, but to evaporation resulting from the death of the tissue. The periods of maximum growth and of maximum transpiration coincide.

(3) Irritability.

Irritability of the Leaves of Dionæa.¶—Dr. J. M. Macfarlane confirms his previous statement that the bristles on the leaves of *Dionæa muscipula* require two successive stimuli to cause closure of the leaf. These stimuli may be exerted on the same bristle, or on different bristles on the same half, or on bristles on opposite halves of the leaf. The interval between the two stimuli may be as much as from 50 to 70 seconds. The closing movement itself is limited to two seconds. With regard to the effects of water on the irritability, while raindrops or a slight current of water falling on the upper surface of the leaf are

* Comptes Rendus, cxv. (1892) pp. 659–61. Cf. this Journal, *ante*, p. 68.

† Ann. Agron., xviii. pp. 369–79. See Journ. Chem. Soc., 1892, Abstr., p. 1508.

‡ Mém. Acad. Roy. Belg., xlvii. (1892). See Journ. Chem. Soc., 1893, Abstr., p. 33.

§ Comptes Rendus, cxv. (1892) pp. 569–74. Cf. this Journal, 1892, p. 823.

‖ Bot. Gazette, xviii. (1893) pp. 56–69 (1 pl.).

¶ Contrib. from the Bot. Laboratory of the Univ. of Pennsylvania, i. (1892) pp. 7–44 (1 pl.). Cf. this Journal, 1891, p. 771.

without effect, a sharp water impact or immersion so as to cover one or more bristles, causes closure. The irritability is not confined to the bristles, but belongs, in a modified extent, to the whole surface of the leaf. A gradual increase in temperature promotes stimulation, but a strong light has no obvious effect.

A full description is given of the secreting glands on the surface of the leaf, as well as of the sensitive bristles. The bristle is not a true hair, but an emergence, and consists of three well-marked regions, the base, the joint, and the shaft. The central portion or joint is the part which is specially irritable. The epidermal cells exhibit abundant continuity of protoplasm. The bristles communicate, by their epidermal and mesophyll portions, with the epiderm and mesophyll of the lamina of the leaf, while the cells of the mesophyll of the lamina appear to be cut off from those of the epiderm by a thickened wall, but communicate directly with the gland-cells. The secretion of the gland-cells is entirely due to irritation of the protoplasm, and is poured out alike as the result of mechanical, chemical, and electrical stimulus. Previous to secretion the leaf is in a state of tetanic contraction.

The author points out the remarkable analogy between the phenomena of irritability in the leaves of *Dionæa* and those of the contractility of animal muscle.

Movements of the Leaves of Melilotus.*—Dr. W. P. Wilson and Mr. Jesse M. Greenman point out that, in addition to the normal daylight position and the night position, the leaves of *Melilotus alba*, and of many other plants belonging to the Leguminosæ and to other natural orders, have a third or hot sun position. This position is not dependent on light alone, but also on the heat rays; and its object is to protect the plant from a too rapid transpiration, by exposing as small an amount of surface as possible to the direct rays of the sun. This is effected in very different ways in different plants.

Heterogenous Induction.†—Herr F. Noll discusses the relationship between heliotropism and geotropism. The nyctitropic movements of leaves may very well, he considers, be of a purely geotropic nature, dependent on the different anatomical structure of the two sides of the leaf. Those sensitive movements in which two different causes cooperate in producing the final result he terms "heterogenous induction," in contrast to "isogenous induction," resulting from one only of the two causes. Those organs he calls "homalotropous" which grow in a horizontal direction. Coiling is a geotropic phenomenon. The seat of the sensitive phenomena he believes to be the parietal utricle of the protoplasm. Heterogenous induction is a widely distributed phenomenon. The ordinary horizontal position of leaves is, for example, the result of the combined action of geotropism and heliotropism.

Cause of Physiological Action at a Distance.‡—M. L. Errera attributes the action of pieces of iron in attracting the growing sporan-

* Contrib. from the Bot. Laboratory of the Univ. of Pennsylvania, i. (1892) pp. 66–73 (5 pls.).

† 'Ueb. heterogene Induction u.s.w.,' Leipzig, 1892, 60 pp. See Bot. Centralbl. liii. (1893) p. 287.

‡ Ann. Bot., vi. (1892) pp. 373–5.

giferous filaments of *Phycomyces* to hydrotropism. He defines hydrotropism, whether positive or negative, as the bending of an organ towards the point, not where it will find a maximum or minimum of moisture, but where it will, within certain limits, transpire most or least.

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

Formation of Calcium oxalate.*—According to Herr H. K. Müller the crystals of calcium oxalate which are found imbedded in the cell-wall of plants are either formed in the membrane itself without contact with the cell-contents, or in the interior of the cell, and are subsequently enclosed in the cell-wall. The former is much the more frequent mode.

Herr H. Warlich † finds a steady increase in the amount of calcium oxalate in leaves during their growth, and even after this has ceased. Under certain circumstances it is again absorbed by the plant.

Influence of Phosphoric Acid on the Formation of Chlorophyll.‡—According to experiments made by Herr O. Loew, phosphoric acid is necessary for the full development of chlorophyll. *Spirogyra majuscula* was grown in a nutrient solution containing 0·2 p. m. calcium nitrate and 0·2 p. m. ammonium sulphate. Elongation of the cells took place, but only to a small extent, and no cell-division; the chlorophyll layer was pale and yellowish, and its movements sluggish. 0·02 p. m. ferrous sulphate was now added, and the culture divided into two portions; 0·08 p. m. disodium phosphate was added to one portion, but not to the other. After five days no change was observed in the latter portion; while the former had become dark green, cell-division took place, and the movements of the chlorophyll became lively.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Hygrophilous Ferns.§—Herr K. Giesenhagen points out the remarkable degree of variation in the structure of the frond of the tropical fern *Asplenium obtusifolium*, between the typical form and the variety *aquaticum*, according as the plant grows in dry or in moist localities. A new species *Trichomanes Goebelianum* is described, of which the rhizome, leaf-stalks, &c., are densely covered with root-hairs.

Oophore-generation of the Hymenophyllaceæ.‖—Prof. K. Goebel describes the prothallium of *Trichomanes rigidum* and *sinuosum* from South America. The former is entirely filiform; the latter partly filiform, partly unilamellar. Both multiply by buds; both are monœcious; in both the archegones are elevated on archegoniophores. The filiform prothallium of *T. rigidum* probably indicates the simplest form of fern, and appears to be closely connected with such simple moss-forms

* 'Ueb. d. Entstehung v. Kalkoxalatkrystallen in pflanzlichen Membranen,' Prag, 1890, 50 pp. and 1 pl. See Bot. Centralbl., liii. (1893) p. 111.

† 'Ueb. Calciumoxalat in den Pflanzen,' Marburg, 1892, 2 pp. and 1 pl. See Bot. Centralbl., liii. (1893) p. 113.

‡ Ann. Agron., xviii. pp. 270–1. See Journ. Chem. Soc., 1892, Abstr., p. 1372.

§ Flora, lxxvi. (1892) Ergänzungsband, pp. 157–81 (3 figs.).

‖ Tom. cit., pp. 104–16 (3 pls. and 1 fig.).

as *Buxbaumia*. Through such prothallium forms as that of *T. sinuosum* we then advance to that of *Hymenophyllum*, and then to that of typical ferns.

Muscineæ.

Cyathophorum.*—Dr. U. Brizi describes the structure of *Cyathophorum pennatum*, belonging to the Hypopterygiaceæ, which is found chiefly on tree-ferns in the southern hemisphere. This moss carries on a saprophytic existence, obtaining its nutriment from the humus in which it grows, by means of cup-like organs of suction attached to the rhizoids, or sometimes by the rhizoids themselves penetrating into the tissue of leaves and through the stomates or other openings; and it appears to pass then from a saprophytic to a parasitic mode of life not hitherto recorded in the case of mosses. In structure the aerial branches and the rhizomes are strongly differentiated from one another. In the branches the hypodermal stereome is weak, while the epiderm itself is strongly sclerenchysed. The leaves consist of only a single layer of cells, each cell with only a single vermiform chloroplast. The vaginule, together with the base of the pedicel, is enormously swollen, forming a reserve-system of food-material. The peristome is furnished with a well-developed aquiferous system.

Rabenhorst's Cryptogamic Flora of Germany (Musci). — The most recently published parts of this work (19–21) complete the account of the European Bryaceæ. The sub-genus *Eubryum* includes 73 species, grouped under four heads, syncœcious, polygamous, autœcious, and dicœcious. The family closes with the new genus *Rhodobryum*, constituted out of Schimper's section Platyphyllum, with one species. The family Mniaceæ is made up of the two genera *Mnium* (23 species), and *Cinclidium* (5 species); the Meeseaceæ of three European genera, *Paludella* (1 species), *Amblyodon* (1 species), and *Meesea* (4 species).

Characeæ.

Antherozoids of Chara.†—Herr R. Franze has examined the structure of the antherozoids of *Chara fragilis*, and confirms, in all essential points, the observations of Schottländer.‡ Each antherozoid consists of an axial filament, which is surrounded by two spiral threads, and the whole structure is enveloped by an extremely delicate membrane. The structure is, therefore, closely analogous to that of the spermatozoa of mammals, as described by Ballowitz.§ Both the spiral threads and the axial filament appear to be elastic. In the nucleus of the mother-cell, while still in an early stage of development, spiral lines can be seen, which appear to mark the origin of the coils of the mature organ, the antherozoid being derived chiefly from the nucleus of the mother-cell. The antherozoids of *Chara fragilis* are therefore spirosparts, elementary constituents of the protoplasm and of the nucleus which have become free.

Rabenhorst's Cryptogamic Flora of Germany (Characeæ).— Parts 7 and 8 of Dr. W. Migula's monograph of the German Characeæ are

* Atti R. Accad. Lincei, ii. (1893) pp. 102–9.
† Bot. Centralbl., liii. (1893) pp. 273–6 (5 figs.).
‡ Cf. this Journal, *ante*, p. 203. § Cf. this Journal, 1891, p. 580.

occupied by descriptions of *Chara ceratophylla, jubata, contraria, strigosa, polyacantha,* and *intermedia.* The varieties and forms of each species, many of them new, are described in great detail, and some of them figured. Of *C. ceratophylla* 20 forms are described; of *C. contraria* no less than 26; of *C. intermedia* 21.

Algæ.

Stenogramme.*—Prof. T. Johnson has investigated the structure and development of *Stenogramme interrupta*, belonging to a genus of uncertain position among the Florideæ. The tetraspores, antherids, and procarps are found on distinct plants, and on both surfaces of the thallus. The tetraspores have a cruciate arrangement, and occur in irregularly placed sori. The antherids form broad flat homogeneous patches of pollinoids. The procarps are very numerous and of comparatively simple form; they occupy a unique position as part of a fertile line extending more or less continuously along the centre of the segments of the thallus. The mother-cells of the carpogenous branches constitute the auxiliary cells; the fertilized carpogone becomes fused by an ooblastema-filament with its auxiliary cell, and the resulting cell becomes the central cell of the developing cystocarp. The cystocarps are formed independently of one another, as the result of the development, subsequently to fertilization, of their own procarps.

Callosities of Nitophyllum.†—Prof. T. Johnson describes the callosities on the tips and lateral branches of the frond of *Nitophyllum versicolor*, which he regards as a gemmiferous state of *N. Bonnemaisoni.* These callosities consist of from twenty to thirty vertical rows of cells containing abundance of reserve food-material, but otherwise of the same structure as those of the stipe. They are apparently organs of vegetative propagation comparable to the gemmæ of the Hepaticæ; on germinating each callosity forms the stalk of a new plant.

Development of Champia.‡—Mr. B. M. Davis describes the development of the frond of *Champia parvula* from the carpospore. Both carpospores and tetraspores were made to germinate. The apical growth of the frond begins, in all cases, from four cap-cells, from which arises the group of initial cells. The last structures to develope in the frond are the hyphæ and the diaphragms; the cap-cells of the segmented spore often divide several times before the hyphæ appear.

New Marine Chantransia.§ — Under the name *Chantransia trifida* Mr. T. H. Buffham describes a new marine species of the genus characterized by having three filaments springing from a single basal cell. The mature plant is not more than from 27 to 30 μ in height, and it is probably the smallest Floridean known.

Chætosphæridium, a new Genus of Algæ.‖ — Under the name *Chætosphæridium*, Dr. H. Klebahn describes a new genus of green freshwater Algæ, with the following diagnosis:—Thallus microscopicus,

* Ann. Bot., vi. (1892) pp. 361–7 (1 pl.).
† Scient. Proc. Roy. Dublin Soc., vii. (1892) pp. 155–9 (1 pl.).
‡ Ann. Bot., vi. (1892) pp. 339–54 (1 pl.). Cf. this Journal, 1889, p. 418.
§ Journ. Quekett Micr. Club, v. (1892) pp. 24–6 (1 pl.).
‖ Jahrb. f. Wiss. Bot. (Pringsheim), xxiv. (1892) pp. 268–82 (1 pl.).

epiphyticus, repens v. scandens, pluricellularis; cellulæ globosæ v. hemisphæricæ, seta vaginata (coleochætoidea) longissima super præditæ, utriculis cylindraceis contentu vacuis interpositis in filamenta brevia subramosa conjunctæ, nucleis chlorophoris pyrenoideisque singulis; incrementum ramificatioque filamentorum divisione cellularum horizontali fiunt, cellulis filiis inferioribus lateraliter in utriculum cylindraceum subinde vacuum excrescentibus, et in extrema parte ejus in cellulam globosam mox setigeram se mutantibus. Propagatio vegetativa zoosporis ex inferiori cellulæ divisæ parte singulatim ortis, per utriculos uncinate ascendentes dimissis fieri videtur (?); zoosporæ earumque dimissio non visæ; generatio sexualis ignota.

The species described, *Chætosphæridium Pringsheimii*, was found growing along with one or two species of *Coleochæte*, with which it has probably hitherto been confounded. The globular or hemispherical cells are somewhat smaller than those of most species of *Coleochæte*, and bear bristles of enormous length, sometimes as much as 200–300 μ. From these setigerous cells a multicellular thallus is formed, which has the peculiarity of branching sympodially, and forming at the ends of its branches globular setigerous cells, into which the whole of the protoplasm and chlorophyll passes, leaving the intermediate tubes empty. The genus is in some respects nearly allied to *Coleochæte*, but should possibly constitute a new family, connecting the Coleochætaceæ with the Chætophoraceæ.

Prof. A. Hansgirg * identifies Klebahn's *Chætosphæridium Pringsheimii* with the plant formerly described by him as *Aphanochæte globosa* var. *minor*, and assigns to it, therefore, the name *Chætosphæridium minus*.

Naegeliella, a new Genus of Brown Freshwater Algæ. †— Under the name *Naegeliella flagellifera*, Herr C. Correns describes a hitherto unknown brown alga, epiphytic on a freshwater *Cladophora*, and apparently allied to *Hydrurus* and *Chromophyton*. It forms gelatinous discs, which are colonies of a unicellular alga, resulting from divisions of the megaspore; the divisions are eventually in all three directions. The ultimate form of the cell is somewhat ovate, and each disc has one or more very fine gelatinous bristles of remarkable length, but difficult to detect without staining reagents; they are simple or branched; the cells are 11–16 μ long and 9–14 μ broad. Each has a nucleus and a conspicuous lobed or curved chromatophore without either pyrenoid or starch. Its colour is a pure deep golden brown; the pigment is apparently identical with diatomin, but differs from phycophæin in its solubility in alcohol, and in its behaviour to acids and alkalies. The cell contains also drops of oil, but no pulsating vacuole could be detected. Propagation is effected by swarmspores (megazoospores), without eye-spot, each provided with two cilia inserted laterally. They were not seen to conjugate, and no microzoospores were observed. The bristles are enclosed in a gelatinous sheath; ultimately a number are formed within the same sheath.

The author considers the nature of the pigment in Algæ to be closely associated with other important differences in structure; and proposes to

* Oesterr. Bot. Zeitschr., xliii. (1893) pp. 56–7.

† Ber. Deutsch. Bot. Gesell., x. (1892) pp. 629–36 (1 pl.).

establish a new class of Xanthophyceæ, parallel with the Phæophyceæ and Cyanophyceæ, to comprise *Hydrurus*, *Naegeliella*, *Phæothamnion*, and *Chromophyton*, with which the Diatomaceæ are closely allied, characterized by containing diatomin.

Myriotrichia.*—Mdlle. N. Karsakoff describes in detail the structure of two species of this genus of Phæosporeæ, *M. clavæformis* and *filiformis*, especially the mode of escape and conjugation of the zoospores. The zoosporanges are of two kinds; in *M. filiformis* the plurilocular contain from 4 to 12 zoospores, in *M. clavæformis* from 8 to 32. The zoospores may escape by either one or two openings. Conjugation was observed to take place only among the zoospores from the plurilocular sporanges, and never between two from the same sporange. The two conjugating zoospores (gametes) were always of unequal size, the smaller one becoming absorbed in the latter. Conjugation takes place either when the zoospores are still in the motile, or when they are passing into the immotile condition. Hauck's genus *Dichosporangium* must be sunk in *Myriotrichia*.

Chlorophyll-bodies of Desmidiaceæ.†—Dr. J. Lütkemüller disputes the validity of the character drawn from the number and arrangement of the pyrenoids for determining the generic characters of desmids.

It is generally given as a character of *Cosmarium* that the number of pyrenoids in each half is always the same, either 1 or 2, and constant in the same species. Dr. Lütkemüller found, on the other hand, a large number of specimens of *C. pyramidatum* with 3, 4, or 5 pyrenoids in each half-cell, and frequently a different number in each half. *C. pseudo-protuberans*, which normally has 1 pyrenoid in each half-cell, was found occasionally with 2 or 3 in one or both. The specific difference between *C. botrytis* and *C. pseudo-botrytis* founded on the number of pyrenoids is not constant. *C. speciosum* has occasionally 2 in each half-cell. A similar variability in the number of pyrenoids was found in *Arthrodesmus convergens* and *Staurastrum echinatum*.

In *Docidium baculum* individuals occur with parietal instead of central chlorophores, thus breaking down the distinction between that genus and *Pleurotænium*.

The author states that in *Pleurotæniopsis tessellata* each chlorophore consists of two layers, one of which is disc-shaped and contains the pyrenoid, while the outer layer consists of ribbon-shaped prolongations, which are directed towards the warts on the surface, ending in them. In *P. de Baryi*, the surface of which is not warty, the chlorophores have a similar structure, and the same is the case with *P. turgida*.

Fungi.

Classification of Fungi.‡—Herr F. von Tavel gives a *résumé* of the relationships of the various families of Fungi, according to the system of Brefeld. He regards the Fungi as being derived from the Algæ, the families most nearly allied to the latter being the Peronosporeæ and

* Journ. de Bot. (Morot), vi. (1892) pp. 433–44 (1 pl. and 2 figs.).

† Oesterr. Bot. Zeitschr., xliii. (1893) pp. 5–11, 41–4 (2 pls.).

‡ 'Das System d. Pilze,' Zürich, 1892, 15 pp. and 1 fig. See Bot. Centralbl., lii. (1892) p. 9.

Saprolegnieæ with sexual, and the Zygomycetes with non-sexual reproduction. In addition to the sporanges, conids now arise, the sporange itself becoming a spore; oidium-forms and chlamydospores are also developed. Already in the Zygomycetes the sporanges may either be free,—exosporangial forms; or may be enclosed in an envelope,—carposporangial forms. The higher fungi, in which there is no sexual reproduction, are connected with the Zygomycetes in two series, a series of sporangial forms which ends in the Ascomycetes, and a series of conidial forms which ends in the Basidiomycetes. The ascus of the former is a sporange; the basids of the latter are conidiophores. The Mesomycetes (Hemiasci and Hemibasidii) are transitional forms between the lower Phycomycetes and the higher Mycomycetes. The whole structure of Fungi points to an adaptation to a terrestrial mode of life.

Red-staining Fungus of Raw Sugar.*—The raw sugar in a factory in Silesia was found covered with red lumps about the size of peas or hazel-nuts. The authors, Herren A. B. Frank and A. Herzfeld, found that these were due to two kinds of organisms, the chief of which was a fungus belonging to the Saprolegniaceæ or Chytridiaceæ. The living filaments were colourless, but when dead they contained a red pigment. The formation of this pigment, which was soluble in water and stained the sugar, was attributed to a small bacillus found in large numbers.

The lumps gave an acid reaction, and if one were thrown into a solution of refined sugar, in the course of ten days 10 per cent. of saccharose would be changed to invert sugar; but to which of the micro-organisms this result is to be attributed is yet undecided.

Influence of Parasitic Fungi on the Host-plant.†—Herr J. H. Wakker has investigated this subject in regard to the following fungi:—*Exobasidium Vaccinii* on *Vaccinium Vitis Idæa*, various species of *Æcidium*, *Rœstelia lacerata* on *Cratægus*, *Puccinia suaveolens* on *Cirsium arvense*, *Xenodochus carbonarius* on *Sanguisorba officinalis*, *Cystopus candidus* on a number of Cruciferæ, *Peronospora parasitica* on *Brassica nigra*, *Exoascus Pruni* on *Prunus Padus*, *E. alnitorquus* on *Alnus glutinosa*, *Urocystis Violæ* on *Viola odorata*, *U. Maidis* on *Zea Mais*, *Plasmodiophora Brassicæ* on roots of *Brassica*. In respect to their influence on the host, he proposes to classify parasitic fungi under the four following categories:—*Cteinophytes*, the influence of which is of a chemical nature only; *Hypertrophytes* (by far the most numerous category), which cause hypertrophy of the tissues; *Isotrophytes*, whioh cause only slight changes, and whose influence is purely chemical; and *Atrophytes*, which induce atrophy of important organs.

The most striking change occasioned by parasitic fungi is the decrease of the mechanical tissue or of thickenings of the cell-wall. This is manifested in the suppression of the collenchyme, of the sclerenchyme, and of the layer of stone-cells, and in the absence of thickening and of lignification of the medullary cells. In this, and in other points, the phenomena of parasitism coincide with those of etiolation. As regards the cell-contents, the formation of chlorophyll and of calcium

* Zeitschr. d. Vereins f. d. Rübenzucker-Industrie d. Deutschen Reichs, xli. (1891) pp. 662–7. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 661–2.

† Jahrb. f. Wiss. Bot. (Pringsheim), xxiv. (1892) pp. 499–548 (5 pls.).

oxalate is reduced or suppressed, while starch is present in abundance. The intercellular spaces are often strongly developed. The secondary tissues—interfascicular cambium, secondary xylem-vessels—are frequently suppressed or reduced. On the other hand, the cells are often increased in size and fresh meristem formed (hypertrophy), pigments are developed in the cell-sap, chlorophyll is formed in the petals and filaments, accessory vascular bundles and abnormal sclerenchyme are produced in the stem.

Fungi Parasitic on Ferns.*—Herr K. Giesenhagen has investigated the structure of the fern from tropical India known as *Aspidium cornu cervi*, now reduced to a variety of *A. aristatum*, and finds the peculiar tufted appearance to be due to the attacks of an undescribed parasitic fungus which he names *Taphrina cornu cervi*. On the outgrowths caused by this parasite other fungi settle, including one which the author makes the type of a new genus *Urobasidium* and of a new family Urobasidieæ. The genus is characterized by having a very fine spider's-web-like mycele, the fertile branches of which are cut off by septa. Laterally from these branches grow the two-celled basids, each producing two colourless spores on short sterigmas; the basids are not united into a receptacle. On *Pteris quadriaurita* was found another undescribed parasitic fungus, named *Taphrina Laurencia*.

The author proposes the following classification of the Protobasidiomycetes, distinguished by their septated basids.

I. Basids septated transversely.
  A. Basids composed of four similar spore-forming cells.
    1. Basids springing from chlamydospores. Uredineæ.
    2. Basids springing directly from the vegetative mycele and forming a receptacle.
      (*a*) Fructification gymnocarpous. Auricularieæ.
      (*b*) Fructification angiocarpous. Pilacrieæ.
  B. Basids composed of two unequal cells, the upper one of which only forms spores. Urobasidieæ.
II. Basids divided longitudinally. Tremellineæ.

Lachnidium Acridiorum.†—M. A. Giard has made a further study of this fungus, so destructive to *Acridium peregrinum* in Algeria. It occurs in two forms:—(1) a *Cladosporium* form, (2) a *Fusarium* or *Fusisporium* form with curved 3–5 septate spores, which likewise produces echinulate chlamydospores. This latter also sometimes gives rise to a *Mytrosporium* form with echinulate spores. The author regards *Lachnidium* as probably belonging either to the Perisporiaceæ or to the Sphæriaceæ, and to be nearly allied to *Cladosporium herbarum*, the ultimate state of which will probably prove to be *Capnodium salicinum* or *Pleospora herbarum*. He believes the fungus not to be a necessary parasite, but rather a saprophyte introduced into the abdomen of the female insect when in a feeble condition.

* Flora, lxxvi. (1892) Ergänzungsband, pp. 130–56 (2 pls.).

† Rev. Gén. de Bot. (Bonnier), iv. (1892) pp. 449–61 (1 pl.). Cf. this Journal, 1892, p. 80.

Fungus-disease of the Plane.* — M. Leclerc du Sablon describes a disease of the plane-tree caused by the attacks of a parasitic fungus *Glœosporium Platani*, with which he unites *G. nervisequum* and *G. valsoideum*. The formation of spores (conids) is described, but no production of ascospores was observed. A receptacle for the conids is formed by decay of the tissue of the leaf or branch, and in this receptacle the conids lie imbedded in a gelatinous substance. Sclerotes are also formed within the receptacle.

Black-rot of the Batatas.†—Prof. B. D. Halsted and Mr. D. G. Fairchild find this disease of the sweet potato, also known as "black-leg," to be due to a parasitic fungus which they name *Ceratocystis fimbriata*. Three kinds of spores were observed:—olive-brown mega-conids in the intercellular spaces and in the cells; colourless micro-conids on the surface; and pycnospores contained in flask-shaped pycnids with a long fringed neck, from which they escaped attached to one another in a lump. Globular sclerotes were also seen.

Cell-nucleus in Yeast.‡—Dr. F. Krasser contests the view of Moeller and others that there is any true nucleus in the cells of *Saccharomyces cerevisiæ*. By artificial digestion in pepsin he determined that the structures so called do not consist of nuclein. The presence of nuclein in the cells of yeast can, however, be shown by both macrochemical and microchemical tests, but it appears to be distributed, in very finely divided form, throughout the body of the cell. The author considers the whole body of the cell to be archiplasm, rather than that the granules of nuclein are the result of fragmentation of a nucleus.

Saccharomyces kephyr.§—M. R. Ferry confirms the statement of Beyerinck that the kephyr of the Caucasus is the symbiotic combination of the zoogloea of a bacterium, *Bacillus caucasicus*, with a saccharomycetous fungus, *Saccharomyces kephyr*.

Herr J. H. Schuurmans‖ has made a careful examination of the properties of this ferment, and, among other things, has come to the conclusion that it does not invert milk-sugar.

Dipodascus, a new Sexual Genus of Hemiasci.¶—Under the name *Dipodascus albidus* g. et sp. n., Prof. G. von Lagerheim describes a fungus found in a mucilaginous slime on a Bromeliaceous tree in Ecuador. The following is the diagnosis of the genus:—Mycele branched, septated, not gelatinous, flocculent; asci without envelope, ascospores numerous, resulting from the conjugation of two cells, and not separated from them by a septum; asci opening at the apex to allow the escape of the spores, which collect into a ball at its mouth; spores unicellular; non-sexual propagation by oidia. The variable size and number of the spores places *Dipodascus* among the Hemiasci, with the greatest affinity with *Ascoidea*. The author regards it as a transitional

* Rev. Gén. de Bot. (Bonnier), iv. (1892) pp. 473–80 (1 pl.).

† Journ. of Mycol., vii. (1892) pp. 1–11 (3 pls.). See Bot. Centralbl., 1893, Beih., p. 59.

‡ Oesterr. Bot. Zeitschr., xliii. (1893) pp. 14–22. Cf. this Journal, *ante*, p. 220.

§ Rev. Mycol., xiv. (1892) pp. 161–2 (1 pl.). Cf. this Journal, 1892, p. 82.

‖ 'Saccharomyces Kefyr,' Utrecht, 1891. See Bot. Centralbl., li. (1892) p. 12.

¶ Jahrb. f. Wiss. Bot. (Pringsheim), xxiv. (1893) pp. 549–65 (2 pls.).

form between the Mucorini and the Ascomycetes, the asci being homologous to the zygospores of the Mucorini and Chætocladiaceæ. Confirmation is thus afforded of the view that a portion of the Ascomycetes are derived from the Zygomycetes.

Vanilla Disease.*—Mr. G. Massee finds that a prevalent disease of *Vanilla planifolia*, in the Seychelles, is due to the attacks of a species of *Hainsea* on the living leaves—identical with *Glœosporium Vanillæ*, previously described from Antigua—the pycnids of which make their appearance on the decaying leaves. These belong to the genus *Cytispora*. If kept damp, the stromata of the *Cytispora*-form produce peritheces, in which no trace of an ascogone has been detected, but which contain asci, each containing 8 ascospores, and identical with those of *Calospora*. These ascospores, on germination, again produce the mycelial or *Hainsea*-form. The correct name of the fungus is, therefore, *Calospora Vanillæ*.

Fungus of Intoxicating Rye.†—M. E. Prillieux has discovered the apotheces of *Endoconidium temulentum*, the fungus which imparts intoxicating properties to rye. They appear to belong to a new species of *Peziza*, which he calls *P. temulenta*, and the genus *Endoconidium* must be sunk in *Peziza*.

Peach-blight.‡—Mr. E. F. Smith has investigated the effects produced on the peach by the destructive parasite *Monilia fructigena*, of which it appears that the conids hibernate in the diseased fruit. The infection takes place almost entirely through the flowers.

Conids in the Uredineæ.§—M. P. Vuillemin records the occurrence of conids in a fungus belonging to the Uredineæ, *Endophyllum Sempervivi*, parasitic on *Sempervivum montanum*. The conids take the place, more or less completely, of the teleutospores, sometimes entirely replacing them. The author regards this as furnishing additional evidence in favour of the affinity of the Uredineæ with the Protobasidiomycetes or Tremellini, a view which is confirmed by an analogy which he points out in the structure of the mycele in the two orders.

Fructification of the Gasteromycetes.‖—Herr H. Rehsteiner has investigated the structure and development of the fructification (sporophore) of a number of Fungi belonging to this order, especially of *Hymenogaster decorus*, *Hysterangium clathroides*, *Rhizopogon rubescens*, *Lycoperdon gemmatum*, *L. laxum*, *Bovista nigrescens*, and *Geaster fornicatus*.

In the immature fructification of *Hymenogaster* the following distinct parts are to be detected,—the peridium, characterized by the dense interweaving of its hyphæ; an interior looser primordial weft, containing large crystals of calcium oxalate; and the rudiment of a central glebe.

* Kew Bull., 1892, pp. 111-20 (1 pl.).

† Bull. Soc. Bot. France, xxxix. (1892) pp. 168-9. Cf. this Journal, 1891, p. 633.

‡ Journ. Mycol., vii. (1892) pp. 36-9. See Bot. Centralbl., lii. (1892) p. 335.

§ Comptes Rendus, cxv. (1892) pp. 895-6.

‖ Bot. Ztg., l. (1892) pp. 762-71, 778-92, 801-14, 823-39, 842-63, 865-78 (2 pls. and 3 figs.).

In *Lycoperdon*, *Geaster*, and *Bovista* the glebe originates in the same way, by the formation of cavities in the central portion of the young sporophore, and the entrance into these cavities of the apices of hyphæ, which subsequently swell up into basids. The subsequent development varies somewhat in the three genera. In the mature structure, *Lycoperdon* displays the greatest degree of differentiation, the sterile portion of the glebe being most fully developed; in *Geaster* this is reduced to a small column, and in *Bovista* disappears entirely. The Hymenogastreæ may be classified under four distinct types, viz. *Hymenogaster*, *Hysterangium* (including *Gauteria*), *Rhizopogon*, and *Melanogaster*. *Phallus* is probably derived from *Hymenogaster*; *Clathrus* from *Hysterangium*; *Bovista*, *Geaster*, and *Lycoperdon* from *Rhizopogon*.

Resting-cells of Merulius lachrymans.*—Herr U. Dammer describes a peculiar condition of the mycele of this fungus, consisting of short deep-brown thick-walled cells, which have apparently a resting function, and probably assist materially in the persistence and spread of dry rot.

Rhizina undulata.†—Prof. R. Hartig finds that conifers are attacked by this parasite only when growing on poor soil. Mycelial structures of the nature of a *Rhizoctonia* spring from the cortex of the root, and produce numerous loop-cells. In the mycele are produced minute *Micrococcus*-like bodies which appear to multiply by budding, and to play an important part in causing decay. The fructification developes in the soil at a distance from the plant attacked.

Mycetozoa.

Absorption and Digestion of Organic Substances by the Plasmodes of Myxomycetes.‡—Dr. L. Celakovsky, jun., gives the results of a number of experiments on the powers of absorption and digestion of living and dead substances possessed by the plasmodes of various Myxomycetes, especially of *Chondrioderma difforme*. The substances employed were:—staminal hairs of *Tradescantia*, Confervoideæ (*Œdogonium*, *Conferva*, *Ulothrix*), Zygnemaceæ, Desmidiaceæ (*Cosmarium botrytis*, *Closterium lunula*), *Scenedesmus*, *Pleurococcus*, *Chlamydomonas*, Diatomaceæ (*Navicula*, *Nitzschia*, *Synedra*), Flagellata (*Euglena*), Ciliata (*Colpoda*), Rhizopoda, Myxomycetes (plasmodes of *Chondrioderma*, *Didymium*, &c.), Fungi (hyphæ, spores of *Penicillium*, *Mucor*, *Phycomyces*, &c.), and bacteria (*Bacillus megaterium*, *B. subtilis*, &c.).

In the case of protoplasts enclosed in a cell-wall no change was observed for several hours, or even for several days; such processes as the growth of germinating fungus-spores, the streaming of protoplasm within the cells of the hairs of *Tradescantia*, the division within the cysts of *Colpoda cucullus*, &c., went on unchanged. Since these processes are dependent on atmospheric respiration, this shows that there must be an excess of oxygen in the protoplasm of the enclosing plasmode. In the case of naked motile cells, such as diatoms, *Chlamydomonas pulvisculus*, &c., the motion was usually at once arrested, whether the object were absorbed into the protoplasm or into a vacuole. When fragments

* Ber. Deutsch. Bot. Gesell., x. (1892) pp. 644-5.

† Forstlich-naturw. Zeitschr., i. (1892) pp. 291-7 (10 figs.). See Bot. Centralbl., liii. (1893) p. 180.

‡ Flora, lxxvi. (1892) Ergänzungsband, pp. 182-244.

of the plasmodes of Myxomycetes themselves are taken up, coalescence takes place between the two plasmodes if they are homogenous, but not if they are heterogenous.

With regard to the nature of the enzyme which causes the digestion, it appears to belong to the class of trypsins rather than to that of pepsins, since the digestion proceeds not only when the reaction is acid or neutral, but also when it is alkaline.

Protophyta.

a. Schizophyceæ.

Development and Classification of Protococcoideæ.*—Herr A. Artari has studied the structure and history of development of a number of Protococcoideæ, especially the following:—*Chlorococcum infusionum*, *Glœocystis Nægeliana* sp. n., *Pleurococcus vulgaris*, *P. simplex* sp. n., *P. miniatus*, *P. conglomeratus* sp. n., *P. regularis* sp. n., *P. Beyerinckii* (*Chlorella vulgaris*), *Dactylococcus infusionum*, *Porphyridium cruentum*, *Raphidium Braunii*, *Chlorosphæra angulosa*, *C. Alismatis*, *C. endophyta*, *C. consociata*, *Chlamydomonas apiocystiformis* sp. n. The general result of his observations is that the species examined are independent organisms, not stages in the development of higher forms; and that, where this has been stated to be the case by other authorities, it has been the result of their having had under observation organisms which are not true Protococcoideæ. The effect of changes in the external conditions on the various organisms was carefully studied.

Chlorococcum infusionum was found to propagate itself exclusively by zoospores or motionless gonids, never by cell-division. *Pleurococcus* is distinguished from *Chlorococcum* by not producing zoospores; it is propagated entirely by cell-division. Several species of this genus exhibit in some points an affinity with the Hydrodictyeaceæ, especially with *Cœlastrum* and *Sorastrum*. *Dactylococcus* was never observed to produce zoospores. *Chlorosphæra angulosa* has both modes of propagation.

The author divides the Protococcoideæ into eight families, viz. Glœocystiaceæ fam. n. (*Glœocystis*, *Palmella*, *Schizochlamys*, *Palmodictyon*, *Palmophyllum*, *Dimorphococcus*), characterized by the cells being imbedded in gelatin or attached to gelatinous stalks, Pleurococcaceæ (*Pleurococcus*, *Eremosphæra*, *Nephrocytium*, *Oocystis*, *Raphidium*, *Scenedesmus*, *Dactylococcus*, *Selenosphærium*, *Crucigenia*, *Actinastrum*, *Porphyridium*), Chlorosphæraceæ, Tetrasporaceæ, Chlamydomonadaceæ (including Phacoteæ), Volvocaceæ, Endosphæraceæ, and Hydrodictyaceæ.

Sporangial Form of Diatoms.†—M. P. Miquel has succeeded, in diatom-cultures, in obtaining the maximum or auxosporal form, often called sporangial, in several species belonging to the Melosireæ and Nitzschieæ, viz. *Melosira nummuloides*, *M. varians*, *Cyclotella comta*, *Nitzschia palea*; the last species is especially favourable for the observation of this phenomenon. When the cell has attained its minimum size by repeated bipartition, its protoplasm swells up, separates the frustules, and escapes to the outside, surrounded by a membrane of cellulose, the existence of which can be demonstrated from the first by reagents.

* Bull. Soc. Imp. Nat. Moscou, 1892, pp. 222–62 (3 pls.).

† Comptes Rendus, cxv. (1892) pp. 615–7.

The cell thus formed gradually assumes the appearance of the species, and the envelope becomes rapidly silicified, and acquires the characteristic markings. This re-establishment of the maximum form does not appear to be preceded by any act of fecundation, nor does it partake, at least usually, of the character of conjugation. Nor is the formation of auxospores or sporanges a constant phenomenon, though it may occur in some species.

Cells of Oscillatoria.*—Herr F. A. Marx has examined cells of *Oscillatoria* for the purpose of determining the presence or absence of a nucleus, and uniformly with negative results; the central portion always remained colourless with staining reagents, though sharply differentiated from the peripheral protoplasm. The granules, which frequently occur on the septa, sometimes apparently cut in two by the septum, were determined to be of an albuminous character, and are probably stores of reserve-material.

Phycocyan of the Oscillatoriaceæ.†—Herr G. Nadson has extracted the colouring matter from species of *Oscillatoria*, and gives its microchemical and optical properties. He considers phycocyan to be most nearly allied to phycoerythrin among the other pigments of Algæ, and to belong to the group of hydrochromes.

β. Schizomycetes.

Myxobacteriaceæ, a new Order of Schizomycetes.‡—Mr. R. Thaxter proposes, under this name, a new group of Schizomycetes, which shows a considerable approach in some respects to the Myxomycetes. They occur as gelatinous growths on decaying wood, fungi, lichens, and other vegetable substances, and on dung. They are motile rod-like organs, multiplying by fission, secreting a gelatinous base, and forming pseudoplasmode-like aggregations before passing into a more or less highly developed cyst-producing resting state, in which the rods may become encysted in groups without modification, or may be converted into spore-masses.

The order comprises Berkeley and Cooke's genus *Chondromyces*, placed by Berkeley among the Stilbiacei, and includes also Berkeley and Cooke's genus *Stigmatella*, and probably also Schröter's *Cystobacter*. In addition to Berkeley and Cooke's two species, *C. crocatus* and *aurantiacus*, two new species are described, *C. lichenicolus* and *serpens*. The diagnosis of the genus is thus given:—Rods forming free cysts, in which they remain unmodified; cysts various, sessile or borne on a more or less highly developed cystophore. In addition the author describes two new genera, viz.:—*Myxobacter;* rods forming large rounded cysts, one or more free within a gelatinous matrix raised above the substratum; with two species, *M. aureus* and *simplex*. *Myxococcus;* rods slender, curved, swarming together after a vegetative period to form definite more or less encysted sessile masses of coccus-like spores; with three species, *M. rubescens*, *virescens*, and *coralloides*. The formation of plasmodes or pseudo-plasmodes appears to present an affinity to the Mycetozoa.

* 'Unters. üb. d. Zellen d. Oscillarien,' Erlangen, 1892 (1 pl.). See Bot. Centralbl., liii. (1893) p. 174. Cf. this Journal, 1888, p. 275.

† Scripta Botanica, iv. (1892) 12 pp. See Bot. Centralbl., liii. (1893) p. 315.

‡ Bot. Gazette, xvii. (1892) pp. 389–406 (4 pls.); and xviii. (1893) pp. 29 and 30.

Influence of Light on Bacteria.*—Herr E. Koltjar has made some experiments in the laboratory of Prof. Batalin, of St. Petersburg, as to the influence of light on *Bac. pseudo-anthracis* [sic], *Sarcina aurantiaca*, *Micrococcus prodigiosus*, and a raspberry-red coccus. Coloured rays were obtained by passing the light through stained gelatin with which the test-tubes were covered. The cultivation media were agar and potato. The author did not notice that the attendant heat exerted any inhibitory influence. The action of the heat-rays was not examined. Sunlight prevented the growth of these non-pathogenic bacteria, but not to the extent which has been described by other observers for pathogenic species. Of the coloured rays the red are favourable to growth, the violet prevent it, yet less so than white sunlight does. The differences of pigment production in the chromogenous bacteria exactly accord with the luxuriance of their growth. The author made the interesting observation that the violet rays favour the sporulation of *Bac. pseudanthracis*.

Diastatic and Inverting Ferments of Bacteria.†—Dr. C. Feroni gives the results of further experiments on bacterial ferments. From these he desired to ascertain if there were microbes other than those already examined by him which possess a diastatic action; if the bacteria generate their ferment action in the presence of substances which contain no proteids; and whether any bacteria are capable of inverting cane-sugar, lactose, and maltose into dextrose, levulose, and galactose.

(1) Of 38 new species examined, only 11 possessed a diastatic action. (2) Eleven formed acid. (3) The *Streptothrix* species (e. g. *Actinomyces*), except *St. carnea*, all formed a diastatic ferment. (4) Many microbes secrete a diastatic ferment without forming acid; others produce acid, but have no ferment action. (5) On media devoid of albumen, none of the bacteria produced a trace of diastatic ferment. (6) None of the glucoside was changed into sugar. (7) Of 62 different species of micro-organisms, only the Kiel bacillus and *Bacillus megaterium* inverted, and about 50 produced acid; all the *Streptothrix* cultures had an alkaline reaction. (8) Of the 62 species examined, 24 formed a proteolytic, 20 a diastatic, and 2 an inverting ferment. Thus, 46 out of 62 microbes possess a ferment. Of these 46 species, 10 form the proteolytic alone, 13 the diastatic alone, and 18 two ferments; *Bac. megaterium* produces all three ferments. (9) Definite relations between the formation of individual ferments and the formation of acid, of pigment, the mobility of the microbes, and their morphological structure, could not be made out.

Leuconostoc mesenterioides.‡—According to Herr C. Liesenberg the organism which is so destructive to cane sugar in the Indies, and especially in Java, is morphologically and physiologically the same as the frog-spawn fungus. This organism causes a disease in the beet-juice used for producing beet sugar in Europe. So that, considering that the differences between the two merely consist in slight differences in rapidity of growth and in the optimum temperature, the Indian fungus

* Wratsch, 1892, Nos. 39 and 40. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 836.

† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 713-5.

‡ Beitr. z. Phys. u. Morph. niederer Organismen (Zopf), 1892, No. 1 (2 pls.). See Bot. Centralbl., lii. (1892) pp. 59-60.

is best described as var. *indica* of *Leuconostoc mesenterioides*, an organism which is classed by Zopf among the Coccaceæ and not among the Bacteriaceæ.

When the organism was cultivated in media containing sugar and with an alkaline reaction, the formation of the jelly sheath was constant, the same condition, in fact, as occurs in the sugar factories. But in certain media, such as potato or substrata devoid of sugar, a sheathless condition, having the microscopic characters of a *Streptococcus*, appears. This forms along the inoculation track a thin flake of whitish nodules. When transferred to a saccharated medium, the frog-spawn form, with its luxuriant growth and gigantic dimensions, reappears.

A special characteristic of both these forms is their resistance to high temperatures, the sheathed form being only killed between 87° and 88°, and the sheathless form between 83½° and 86½°, while most Schizomycetes and yeasts die between 55° and 70°.

Leuconostoc mesenterioides can ferment grape sugar, cane sugar, milk sugar, malt sugar, and dextrin; but, except the ferment which inverts cane sugar, it does not seem to produce an enzyme either diastatic or peptonizing.

Bactericidal Influence of the Blood.*—Herr H. Kionka records experiments made for the purpose of testing the extra-vascular bactericidal influence of the blood, and deciding if this action be a phenomenon induced by physical or chemical processes, or whether it is to be ascribed to the specific property possessed by the blood as blood.

The author's experiments cover the same ground as those of de Christmas,† and are intended to show that the results obtained by the latter may receive a different interpretation. The first set of experiments made with anthrax and typhoid bacilli went to show that sudden change from one cultivation medium to another did not abolish the bactericidal influence. In the second set anthrax and typhoid bacilli and *Staph. py. aureus* were cultivated in body-juices (pleuritic exudate and hydrocele fluid), and exposed to the influence of CO_2 after the cultivation media had been heated to 55°, the point at which body-juices lose their bactericidal influence. The author failed to discover that CO_2 had any power to inhibit the growth of micro-organisms.. The third series was made with typhoid bacilli, (*a*) fresh from the human body, (*b*) old cultivations on artificial media. The cultivations were made on various media, human blood-serum, peritoneal and pleural exudations, and the results showed little difference between the two kinds.

Is the bactericidal property of blood-serum a vital phenomenon, or merely a chemical process? Such is the question propounded by Prof. R. Emmerich, Prof. J. Tsuboi, Dr. Steinmetz, and Dr. O. Löw,‡ and their experiments were directed towards the nature of the microbicidal proteids of serum. To solve the problem, it was necessary to obtain the serum proteids in a pure condition, and then to restore the activity and germicidal property to those proteid substances which had been rendered inert by chemical processes, such as precipitation, drying, &c.

From *a priori* considerations this would appear an impossible task;

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 321–9.

† Cf. this Journal, 1892, p. 252.

‡ Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 364–72, 417–26, 449–58.

but the authors are satisfied with the results of their experiments, showing that this difficulty has been overcome. In the first set of experiments the serum was precipitated and then dissolved in water. In the second set the serum-albumen was precipitated with alcohol, and dissolved in 0·04 to 0·05 per cent. potash solution. In the third set the serum-albumen-potash solution was heated to 60°–63° C. They conclude from the results of these experiments that the microbicidal property of blood-serum is not a vital phenomenon, but is merely a chemical process.

In the course of their remarks the authors point out that on two occasions in the series where they were dealing with the alkalinized serum heated up to 60°, the number of bacilli was obviously diminished. This is the strongest proof they bring against the position of Buchner, who attributed the bactericidal power of serum to some inherent (vital) property; since if heated to 55° this power was lost. That it is due to alkalinity they think is shown by the action being increased by alkalinity and being decreased by acidity, a position very similar to that taken up by Von Fodor some years ago. Von Fodor showed that by augmenting the alkalinity of the blood the bactericidal power was increased.

Bacterium coli commune and Peritonitis from Perforation.*—During the winter 1890–91 there was an epidemic of typhoid in which perforation occurred with some frequency. The exudation from six cases of diffuse suppurative peritonitis resulting from perforation of the lower part of the ileum, was examined by the plate method by O. Barbacci. Direct subcutaneous and intraperitoneal injections with the exudation in bouillon were made on rabbits and white rats. From four of the six cases plate cultivations were made from the intestinal contents taken from the floor of the perforating ulcers. In the cultivations of all the six cases one organism, *B. coli commune*, was present. Cultivations from the heart's blood of two cases were sterile, and in two cases *B. coli commune* was present. In three cases the presence of Fraenkel's *Diplococcus* was observed, and the virulence of this organism was soon lost when passed through two or three animals. Agar cultivations of *Diplococcus* developed poorly, and after two or three transferences failed. These considerations led the author to believe that the *Diplococcus* must have lost vitality and virulence in the exudation, and that therefore its share in the production of peritonitis was inconsiderable, a supposition supported by the fact that it could not be demonstrated in three cases. Experiments were made in order to differentiate *B. coli commune* from the typhoid bacillus and from *B. pyogenes fœtidus*.

The author also mentions that he has produced diffuse peritonitis in rabbits and guinea-pigs by means of *B. coli commune* in filtered and sterilized diarrhœa stools; and also that in a case of peritonitis after perityphlitis, *B. coli commune* was demonstrable in the pus removed during life.

Demonstrating Typhoid Bacilli in Drinking Water.†—During an epidemic of typhoid fever, Herr L. Kaman had an opportunity of

* Lo Sperimentale, 1891, p. 313. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 257–8.

† Centralbl. f. Bakteriol. u. Parasitenk., xi. (1892) pp. 33–40. See Bot. Centralbl., lii. (1892) p. 53.

demonstrating the presence of typhoid bacilli in the water supplied to the barracks of the soldiers among whom the disease had broken out. The method adopted was that of Parietti, and the procedure was as follows :—Several test-tubes are filled with 10 ccm. of neutral bouillon, to which has been added 3–9 drops of 5 grm. carbolic acid and 4 grm. of pure hydrochloric acid in 100 grm. of distilled water. The tubes are then incubated for 24 hours, and if they still remain unclouded, 1 to 10 drops of the suspected water are added. If typhoid bacilli be present the tubes become cloudy, and they are afterwards easily isolated by the plate method.

Bacterium from Acid Urine.*—Herr Heim records a case of incontinence of urine occurring in a male aged 20. There was a family history of vesical affection. The urine passed was acid, and contained leucocytes and a particular bacterium. There was no evidence of a gonorrhœal or tubercular affection. Plate cultivations were made from the urine obtained with antiseptic precautions, and there grew up in a few days numerous colonies of variable size, usually circular with well-defined edge, and of a brownish-yellow colour. The gelatin was not liquefied. The colonies were composed of short plump rods with rounded ends. The bacterium was devoid of motion, was an acid-former, turning Petruschky's litmus solution red, and was strongly aerobic. Its development was inhibited by the presence of hydrogen. The same bacterium was easily demonstrable in the urine, and in the leucocytes therein. It stained well with the anilin solutions most in vogue, such as phenol-fuchsin, alkaline methylen-blue, &c., and also by Gram's method, a point which served to distinguish it from *Gonococcus*. Experiments made on animals, both as regards its general pathogenic action and its special action on the urine when injected into the bladder, were negative.

Restoring Spore-formation to Asporogenous Anthrax.† — M. C. Phisalix finds that the loss of spore-formation in anthrax is due to the combined action of heat, air, and slow oxidation of the protoplasm. Absence of oxygen acted conservatively, and spore-formation was preserved. Yet the restoration of the spore-forming faculty was not effected by continued cultivation in imperfect vacuum.

By cultivating anthrax which had remained asporogenous for several months, and through several generations, on thin layers of bouillon to which some quite fresh guinea-pig's blood had been added, the spore-formation at once returned. It is to be noted that in the so-called asporogenous anthrax, pseudo or rudimentary spores are always present, and that they differ chiefly from true spores in their feeble resistance to heat.

Presence of Bacterium coli commune in corpses.‡— MM. Wurtz and Hermann, from an examination of thirty-two bodies, note the frequent presence of *Bacterium coli commune* in the human corpse. From 24–36 hours after death gelatin plates were inoculated from liver, spleen,

* SB. Physikalisch-Medicinischer Gesellschaft zu Würzburg, 1892, pp. 56-64.

† Comptes Rendus, cxv. (1892) pp. 253-5.

‡ Arch. de Méd. Exp. et d'Anat. Pathol., iii. (1891) No. 6. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 388-9.

and kidneys, and in sixteen cases *B. coli commune* was found in the liver, twelve times in the kidneys, and six times in the spleen. The authors specially remark on the polymorphism of the bacterium, and describe two principal varieties which can only be distinguished by the shape of the colonies on gelatin plates. One of these bears considerable resemblance to the appearance of typhoid colonies; and as the latter betrays notable variations when cultivated on plates, the authors think that it is not possible to differentiate *B. typhosus* from *Bact. col. commune* cultivations. Nor did experiments made on animals aid in establishing any diagnostic criterion.

Invasion of Subcutaneous Tissue by the Diphtheria bacillus.*—Dr. C. H. Spronck found, after examining the bodies of three children who had died a few days after tracheotomy for diphtheria, that the subcutaneous tissue round about the wound was œdematous. On sectioning this, it had a yellowish-red appearance, and seemed spotted with small hæmorrhages. In two cases it had spread up over the clavicles, and down as far as the thorax, yet the wound itself was not covered with any membrane, nor had an unhealthy appearance. Cultivation experiments showed that diphtheria bacilli were present all over the œdematous swelling. A similar œdema has been frequently observed in animals, especially in rabbits, when the trachea has been opened.

Bacillus of soft Chancre.†—MM. Nicolle and Quinquand have for some weeks past found in every case of soft chancre the bacillus described by Unna, and in enormous numbers. The microbe is a bacillus with rounded ends, usually in chains, and found in the lymph and intercellular spaces, never in the cells themselves. The staining method indicated by Unna they declare to be unsatisfactory, and they obtained the best results with a phenol-methylen-blue solution. Cultivation experiments were unsuccessful.

Spirillum luteum.‡—M. H. Jumelle describes a chromogenous bacterium which he isolated on peptonized veal broth from fragments of decomposing *Sphagnum*. In about six days the medium became cloudy, and pure cultivations were obtained on plates. When grown on gelose or potato, lemon-coloured colonies are formed. Gelatin stroke cultivations showed signs of liquefaction in about seven or eight days. In puncture cultivations the yellow colour was only developed near the surface, and if the medium be covered with a layer of sterilized oil no development takes place. Hence the bacterium is essentially aerobic. It can exist in the absence of nitrogen; and in starchy media mixed with some saline matters glucose is formed. The presence of acids and antiseptics either inhibited or prevented development; but if the organism were able to develope at all it was always yellow coloured, except in peptonized bouillon. The microbe grows very well in milk, coagulates it, and forms a thick yellow scum on the surface.

In shape the bacterium is a thin bent rod, much resembling the comma bacillus when cultivated in bouillon. Sometimes the rods are

* Centralbl. f. Allgem. Pathol. u. Pathologisch. Anatom., iii. (1892) No. 1. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 339.

† La Semaine Méd., 1892, No. 35. See Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) p. 564.

‡ Comptes Rendus, cxv. (1892) pp. 843-6.

markedly curved, and occasionally S or E forms are seen. The dimensions of the microbe appear to vary considerably, according to the nature of the medium and the environment, but in all cases the bacterium is mobile; and in starch mixed with saline substances the characters of the micro-organism present a notable difference. All the rodlets are straight, and nearly as broad as they are long.

The author places this bacterium in the genus *Vibrio*, and points out that its different characters distinguish it very clearly from the chromogenous curved bacteria. In short, *Spirillum luteum* is a curved, yellow, mobile bacterium, which is telluric, and essentially aerobic. It slowly liquefies gelatin, and can exist in non-azotized media. Under the latter circumstances it loses its curved bacillus form and assumes an almost spherical shape, so that it resembles a coccus.

Penetrability of the Skin for Microbes.*—Dr. B. Wasmuth finds that the healthy uninjured skin of man and animals is penetrable by micro-organisms, and that the path of access lies between the shaft and sheath of the hairs, the sebaceous and sweat glands not allowing the entrance of infection. Experiments were made by rubbing pure cultivations of *St. pyogenes albus* and *aureus* into the skin of the hand and arm with the middle finger of the opposite hand. *Staphylococci* and erysipelas cocci were rubbed into rabbits, guinea-pigs, and white mice, and virulent anthrax into guinea-pigs.

Most of the experiments made by the author on himself with the *Staphylococci* appear to have been successful, as foci of suppuration in the centre of which hairs stood appeared after inunction. Nearly all the experiments made with the *Staphylococci* on animals were failures, but all the anthrax inoculations took. Sometimes the cultivations were mixed with lanolin before inunction, and this vehicle did not seem to interfere with the action of the microbes in any way.

Flies and the Spread of Cholera.†—Dr. J. Sawtschenko, who has been making experiments as to the relation between the spread of cholera and flies, finds that it is easy to demonstrate the presence of cholera bacteria in fly-excrement passed for two or three days after having been fed on pure cholera cultivations. Under these circumstances, the flies—which were ordinary house-flies and bluebottles—were fed, after infection with the cholera-cultivation, on sterilized bouillon. If, however, they were fed on raw meat a number of saprophytes were mingled with the cholera bacilli.

If the flies were fed on intestinal contents of cholera corpses, all sorts of bacteria were demonstrable in their excrement. The cholera bacteria lost none of their virulence during their transit through the fly's intestine; and the experiments further showed that other vibrios retained their virulence under similar conditions and for similar periods (2 or 3 days).

The author concludes that flies serve not only to spread infection directly, but that each patch of excrement must be reckoned as a further centre for the extension of the disease.

* Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 824-7, 846-54.
† Tom. cit., pp. 893-8.

Putrefactive Processes in large Intestine, and Micro-organisms which induce it.*—Dr. Zumft describes experiments made for the purpose of ascertaining how the decomposition of albuminoid substances would be affected *in vitro* by means of a mixture of microbes such as normally inhabit the human colon. The general plan was to roughly imitate the natural conditions, and with this intent an infusion of finely chopped meat was, after sterilization, inoculated with some fresh excrement, rendered semi-liquid by mixing it with 1 ccm. of water. The flask was then emptied of air, filled with carbonic acid, and then incubated at the body temperature.

The chief result from these experiments appears to be that putrefactive processes take place slowly in the absence of air and presence of carbonic acid. After several days—sometimes after several weeks—all the material is not decomposed. This is in conformity with the fact that all the fermentations proceed more slowly without than in the presence of air.

From among these putrefactive bacteria the author isolated a facultative anaerobic microbe capable of decomposing albumen and sugar in the presence or absence of air. It forms little round colonies in gelatin and gelose. In hanging drops the cells appeared to be mobile. The bacterium was found to be pleomorphic, and exhibited great variation in size. It was easily stained by anilin dyes, but was decolorized by Gram's method.

Gas-forming Bacillus from Urine in Cystitis.†—Dr. W. Schow has isolated a micro-organism which he calls *Coccobacillus aerogenes vesicæ*, from a case of compression myelitis. There was incontinence, cystitis, and the urine had a peculiar sulphurous odour. The reaction was faintly acid, and the deposit contained bladder epithelium, white blood-corpuscles, and some bacteria. The latter consisted of cocci and short thickish rodlets, stainable with the usual anilin dyes and not decolorized by Gram's method.

The micro-organism was cultivated on plates by mixing some urine with meat-peptone-gelatin.

The colonies were small, round, and yellow. The gelatin was not liquefied, and the most characteristic result was the formation of a considerable quantity of gas, which, from analysis, appeared to be CO_2.

That there was some causative connection between the cystitis and this bacterium was probable, from only one other micro-organism being found; but this was demonstrated to be an accident and unconnected with the peculiar odour.

Coccobacillus aerogenes vesicæ is not pyogenic, as experiments on animals showed.

The author's account does not shed much light on the sulphurous odour—the special inducement to examine the urine bacteriologically.

Bactericidal Action of Blood-serum.‡—When normal blood-serum, says Prof. H. Buchner, is heated up to 55° it loses (as is well known) its germicidal influence, and becomes inactive. Three hypotheses as to

* Arch. Sci. Biol. Inst. Imp. de Méd. Exp. à St. Pétersb., i. (1892) pp. 497–516.
† Centralbl. f. Bakteriol. u. Parasitenk., xii. (1892) pp. 715–9.
‡ Tom. cit., pp. 855–8.

the changes which have occurred in the alexins are conceivable :—there is a disturbance in the micellary arrangement of the unchanged chemical molecules ; or there is some alteration affecting the chemical molecules alone, the micellary arrangement remaining unaltered ; or, finally, a simultaneous change occurs in both directions. The author inclines to the first explanation, and Prof. Emmerich, with collaborators, supports the second hypothesis.

The experiments of the latter showed that the germicidal action of blood-plasma is a purely chemical phenomenon, while Prof. Buchner advocates the vital action of serum. He has repeated the experiments of his opponents after the manner laid down by them, and finds that their conclusions are erroneous, although he does not dispute some of their facts. The repeated experiment as recorded is divided into four parts :—(*a*) showing the result of the action of active serum ; (*b*) of inactive serum ; (*c*) of inactive serum treated with potash and dialysed ; (*d*) the latter further heated to 60°. These four serums were inoculated with *Bacillus coli* and examined after three and five hours.

In *a* the count made 68 ; in *b*, 352,000 ; in *c*, 12,300 ; in *d*, 14,500. In *a* there was a progressive diminution in the number ; in *b*, a progressive increase ; in *c* and *d*, a slight diminution up to 3 hours, after which a decided increase.

From this it would appear that, while the statements of Emmerich and his collaborators are true as far as they go, the inference drawn by them was not justifiable, as it was founded on insufficient data.

The bactericidal action of the blood-plasma at present, therefore, retains its position.

Sternberg's Bacteriology.*—By far the most important work on Bacteriology which has been written in the English tongue hails from America. It claims to be a manual ; it is rather a treatise, dealing with our present knowledge of bacteria. As a book it deserves great praise, for it is well got up, and excellently illustrated by heliotype and chromolithographic plates and 268 engravings. The work is divided into four parts, the first of which deals with classification, morphology, and general bacteriological technology. The second part is devoted to general biological characters ; while the third and fourth discuss pathogenic and saprophytic bacteria. It is, perhaps, in part three that the work is most interesting, though the information in part four is certainly copious and (as far as our present knowledge goes) reliable. Together, parts three and four take up at least two-thirds of the whole volume. It may be gathered from this that the work, as a book of reference, is as complete as it could have been made.

As may be observed from even a casual inspection, the book contains a large amount of original work ; but due acknowledgment is given to works of other authors, and where borrowed illustrations are given, these have been reproduced most excellently, and are not (as is usually the case under similar circumstances) indifferent murky-looking resemblances.

At the end a copious bibliography is given. In our opinion, the

* 'Manual of Bacteriology,' by G. M. Sternberg, M.D., Dep. Surgeon-General U.S.A., New York, 1892.

work ought to be widely known, but the first intimation of its existence came only a short time ago in the ordinary course of notice, though from the preface it would seem to have been issued in April 1892.

Micro-organisms of the Mouth.*—Dr. W. D. Miller has recently published the second edition of his work on the micro-organisms affecting the mouth, which also deals with the local and general diseases resulting therefrom. The present edition has been thoroughly revised and much enlarged: it contains 448 pages, and is illustrated by 134 engravings and 18 photographs.

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Günther, C.—**Ueber eine neue, in Wasser gefundene Kommabacillenart.** (On a new Species of Comma-bacillus found in Water.) *Deutsch. Med. Wochenschr.*, 1892, pp. 1124–5.

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Schutzenberger, P.—**Les fermentations.** 5th ed., Paris, 1892, 8vo, figs.

Stagnitta-Balistreri—**Die Verbreitung der Schwefelwasserstoffbildung unter den Bakterien.** (The Distribution among Bacteria of the Formation of Sulphates.) *Arch. f. Hygiene*, XVI. pp. 10–34.

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* 'Die Mikroorganismen der Mundhöhle,' Leipzig, 1892. See Centralbl. f. Pakteriol. u. Parasitenk., xii. (1892) p. 868.

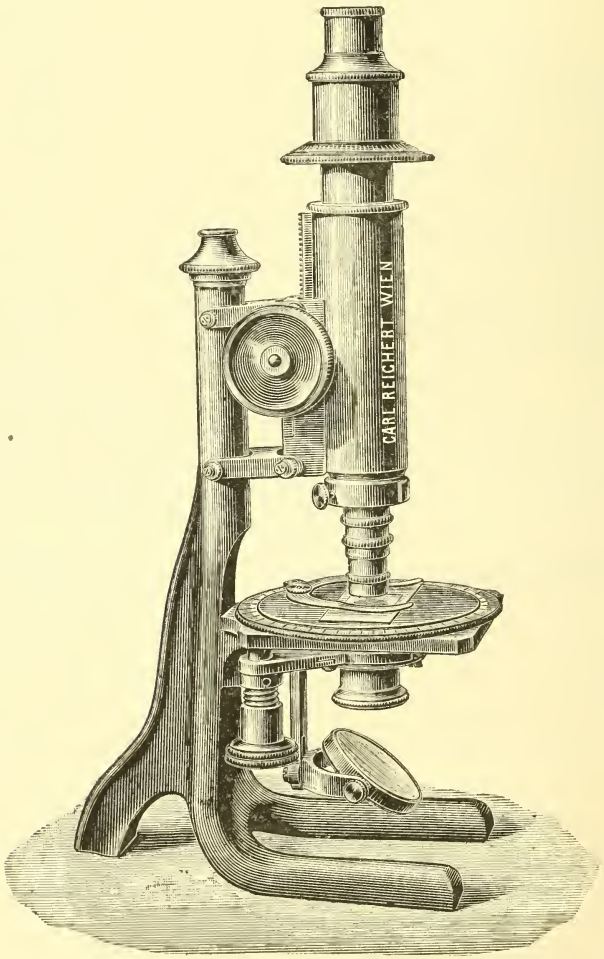
MICROSCOPY.

a. Instruments, Accessories, &c.*

(1) Stands.

Reichert Microscope.—The model No. VII. *b*, shown in fig. 39, is provided with coarse-adjustment by rack and pinion, and fine by micrometer screw. The large circular movable stage is divided into 360°.

Fig. 39.



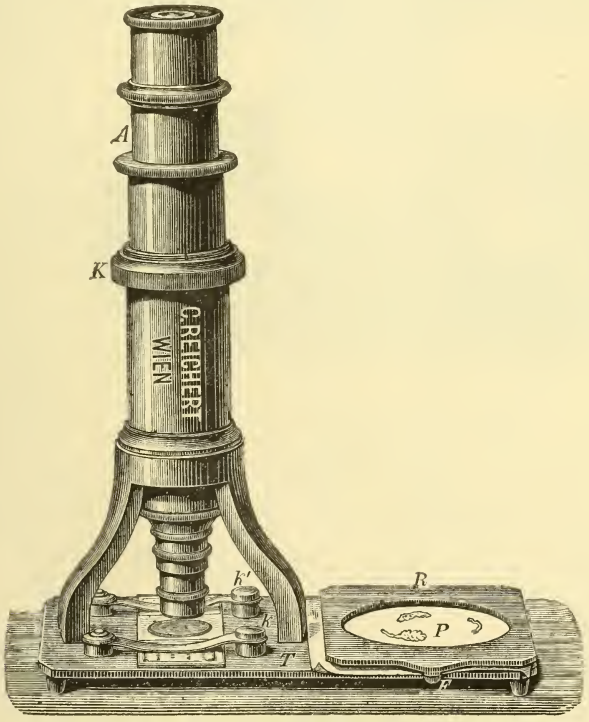
* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

In the polarizing apparatus of large field of view, both nicols can be easily rotated, while the under one is attached to a side arm, so that the conversion from polarized to ordinary light can be rapidly effected.

The instrument is also provided with centering apparatus for the objective, Bertrand's condenser, and mirror, plane and concave, which is adjustable in height and on both sides.

Reichert Hand-Microscope.—This model, represented in half its natural size in fig. 40, is intended for lecture and school work, &c. The focal adjustment is effected by sliding in a socket. The stage projects

Fig 40.



to one side, where it is provided with a frame under which there can be clamped a piece of paper, on which the structures observed in the Microscope can be drawn.

(3) Illuminating and other Apparatus.

Reichert's Illuminating Apparatus.—This apparatus, represented in figs. 41 and 42 as arranged for all modifications of direct and oblique light, consists of:—(1) A condensing system of great intensity with aperture of 1·20 or 1·40; (2) a diaphragm-holder with iris-diaphragm,

together with an arrangement for raising and lowering; (3) a cylinder diaphragm.

Fig. 41.

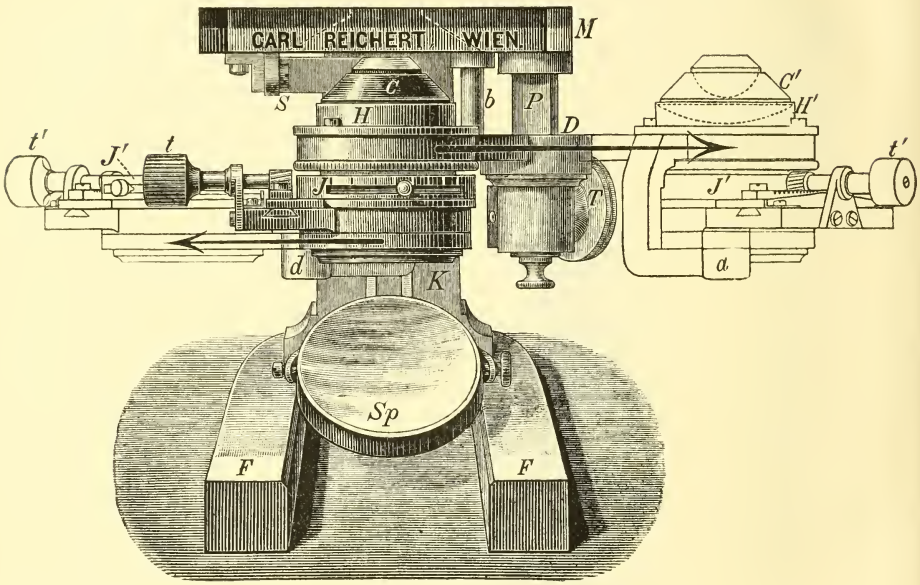
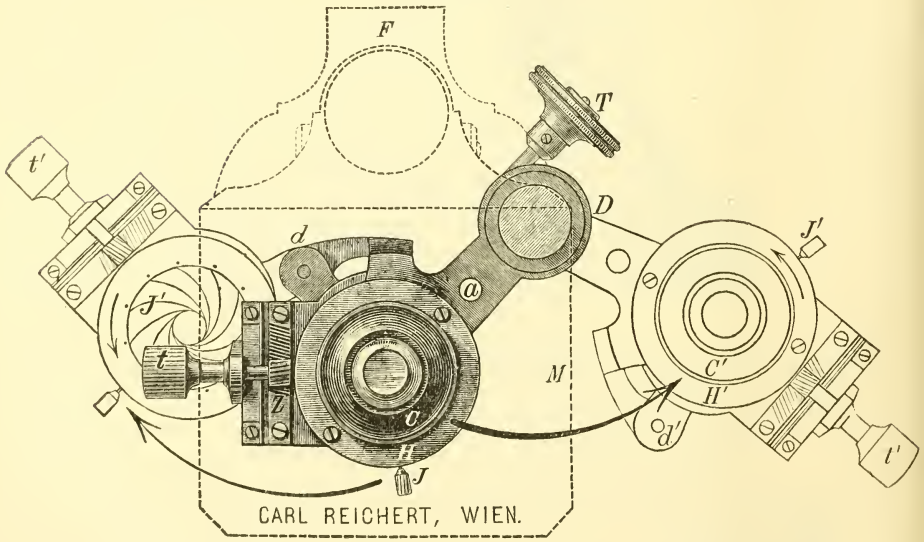


Fig. 42.



To ensure a constant centering of the apparatus, it is made of a single massive piece, in the socket of which fits either the condenser

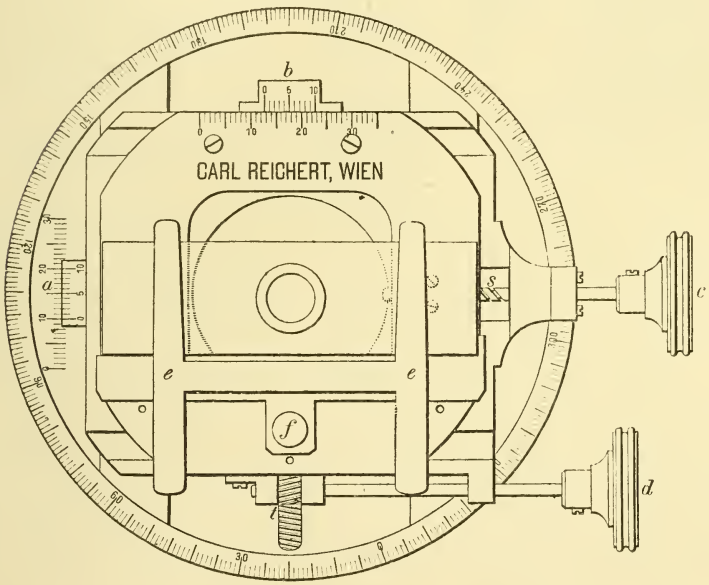
or the cylinder diaphragm. The iris diaphragm which is attached to the same piece gives an aperture of from 1 to 32 mm.

The central illumination is marked by the snapping of a spring. Oblique illumination is effected by turning the screw-head *t'*. The whole illuminating apparatus is attached to the prism P in such a way that it can be easily raised and lowered by means of the screw-head T, while the pin *b* serves as a guide for the exact centering

For the introduction of blue glass, polarizer, &c., the iris diaphragm holder can be separated from the condenser and displaced from its central position to one side in the direction of the arrow *t'*.

Reichert Movable Object-stage.—The latest form of this stage is represented in two-thirds its natural size in fig. 43. The screw-head and pinion by means of which the displacement of the objects in two

Fig. 43.



rectangular directions is effected are placed side by side. Both slides are provided with scales and verniers, and the circumference of the stage with a divided circle.

For the reception of culture-plates the object-holder *e e* can be removed by raising the screw *f*.

This stage is only used on Reichert stands No. 1 *a* and 1 *b*.

Optical Projection.*—Sir David Salomons, in a lecture before the Royal Institution, gave a general survey of the subject of Optical Projection. The apparatus employed was a modified form of that of Mr. Lewis Wright, and was constructed by Messrs. Newton, of Fleet

* Proc. Roy. Inst., xiii. (1893) pp. 534–9.

Street. Instead of the usual lime-light an arc-lamp was the means of illumination, and many difficulties in the use of this light had to be overcome.

Very high magnifications were not attempted, as the projection method is not adapted to give good results under these conditions.

When projecting with an objective alone, this has to be brought very close to the slide, with high powers closer than the cover-glass will allow. In this case special substage condensers are necessary. This difficulty is more especially felt when the arc-light is employed instead of the lime-light. It can be surmounted either by the introduction of plano-concave lenses on the screen side, which have the effect of giving a greater working distance, or preferably by using an eye-piece.

In the eye-piece method adopted by the author almost the exact conditions can be complied with for which the objective was made.

Owing to the field not being flat, all parts of the objects cannot be brought into focus at once, but only successively by slightly shifting the focusing screw. It is only with very considerable depth of focus that for projection work over-correction for flatness can give a sharp picture, since without great care certain forms of distortion will be introduced. By stopping down the objective greater flatness may be secured, but only at the expense of light.

The author exhibited various microscopic objects by projection under different magnifications. The screen distance was 21 ft. The lenses and magnifications employed were as follows:—

First, a 35-mm. Zeiss projection objective, 4-in. substage condenser, Zeiss Huyghens eye-piece 2; 500 diameters = 250,000 times = penny stamp stretched to cover about 147 square yards.

Second, a 1-in. Newton's projection objective, 4-in. substage condenser, Zeiss Huyghens eye-piece 2; 1000 diameters = 1,000,000 times = stamp stretched to about 588 square yards.

Third, 1-in. Newton's projection objective, 4-in. substage condenser, Zeiss Huyghens eye-piece 3; 1300 diameters = 1,690,000 times = stamp stretched to about one-fifth of an acre.

Fourth, 1/4-in. Zeiss's achromatic objective, Abbe's 3-lens substage condenser, with top lens removed, Zeiss Huyghens eye-piece 3; 4500 diameters = 20,250,000 times = stamp extended to nearly $2\frac{1}{2}$ acres.

With the polariscope various objects, such as glass in a condition of strain, Rupert's drops (broken in the field), and mineral sections, were exhibited, both in parallel and convergent light.

With the solidiscope, a new form of apparatus for exhibiting solids, and consisting of two reflecting prisms and suitable projecting lenses, were shown Barton's button, the works of a watch, and a coin.

A spectrum was projected upon the screen by a new method which, by means of a carbon disulphide prism combined with a reflecting prism or with a mirror, gives practically a direct spectrum without the necessity of turning the lantern.

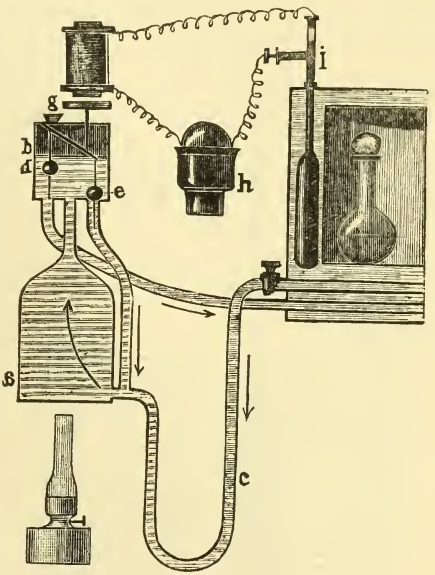
Electrical Thermostat.*—Mr. W. P. Kurtschinski has devised a thermostat with an electric regulator and heated by a mineral oil lamp.

* Wratsch, 1892, p. 744. See Zeitschr. f. wiss. Mikr., ix. (1893) pp. 473-4 (1 fig.)

The apparatus works in the following way:—The water in the reservoir *a* is heated by a mineral oil lamp. The current of hot water rises through the middle pipe to the upper compartment of the reservoir and passes down into the thermostat through the pipe on the left, and returns by the pipe *c*.

On reference to the illustration it will be seen that when the ball *d* sinks the ball *e* rises and the hot current will be diverted into the pipe *c*, and the stream pass in the contrary direction back again into the reservoir *a*. In this way the equilibrium of the water-heat in the thermostat is maintained.

Fig. 44.



The automatic rise and fall of the balls is brought about by the attraction and repulsion of the armature *g* by an electro-magnet while the opening and closing of the electric current (*h* is a Meidinger's element) to the magnet is effected by the rise and fall of the mercury in the regulator *i*. The latter is an ordinary Reichert's regulator without the upper funnel. One end of the conducting wire is connected with the upper end of the regulator, the other with the side branch. When the water gets too hot the mercury rises and touches the upper wire and so closes the circuit. The armature *g* is attracted and the ball *e* drawn up, while *d* sinks down and thus the hot water ceases to pass into the thermostat. When the water cools the mercury sinks and the current is broken, the balls assume their former position and hot water again passes into the thermostat. The author is extremely satisfied with the working of the apparatus.

Heydenreich's Regulator and Remarks on Thermostats.* — Dr. L. Heydenreich describes a modification of Altmann's thermo-regulator † which he has used for some time and has found to be very sensitive.

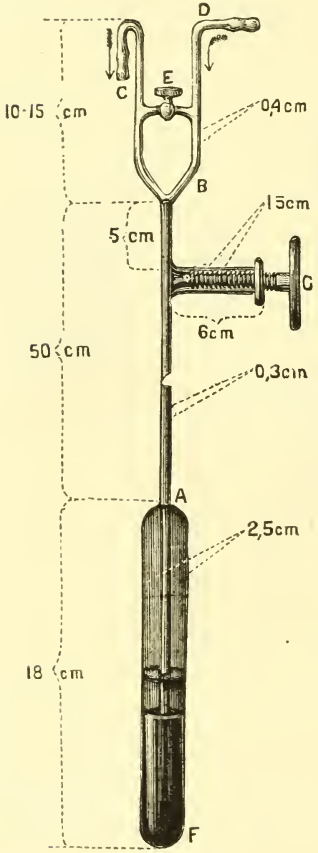
The reservoir A F contains mercury above which is a layer of ether. When the temperature of the water mantle becomes too great the ether vapour presses on the mercury and the latter rises in the tube F A B until it reaches the bifurcation, when it prevents the gas from passing along in the direction D B C, permitting only a small stream to flow through E, a stream just sufficient to keep the burners alight. To ensure more perfect accuracy of regulation the wall of the reservoir should

* Zeitschr. f. wiss. Mikr., ix. (1893) pp. 300–6 (2 figs.).

† This Journal, 1891, p. 651.

be as thin as possible (not too thin as it has to stand the pressure of about 5/6 atmosphere), that of the tube F A B should be thick and the tap E should be nearer D than B. This arrangement aids first of all in preventing the extinction of the flame when the thermostat gets too hot and also saves the apparatus from getting damaged from the action of the mercury on the metal if, as is sometimes the case, it rises above the level of E. Owing to the sensitiveness of the apparatus it is necessary to have the lateral regulating tube G fairly broad, otherwise it would be necessary either to let out or put in mercury for different temperatures.

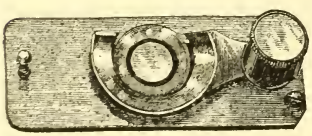
Fig. 45.



The author then goes on to point out that notwithstanding a thermo-regulator may be extremely sensitive yet there are two principal causes which prevent the temperature of a thermostat from being constant. These are the irregular heating of the bottom, and the difference in the heat of the water mantle owing to imperfect mixture of the currents. To obviate these inconveniences as far as possible it is necessary that all the burners should act simultaneously and in concert with the regulator; secondly, that the heating of the bottom should be distributed evenly over the whole surface by the interposition of wire gauze; and thirdly, that the thermostat should be covered over with a protective such as asbestos. The bottom should be somewhat conical as the heat is better distributed by this formation than when flat.

Rousselet's New Compressorium.—This compressor has been devised for the purpose of facilitating the examination of minute living and free-swimming animals, such as rotifers, infusoria, &c. The accompanying woodcut renders a detailed description unnecessary. The advantages claimed for it are the following :—

Fig. 46.



The glass tablet being fixed flush with the lower part of the brass slide, which is slightly countersunk, allows high-angled condensers to be used to the very edge of the tablet for the illumination of the objects.

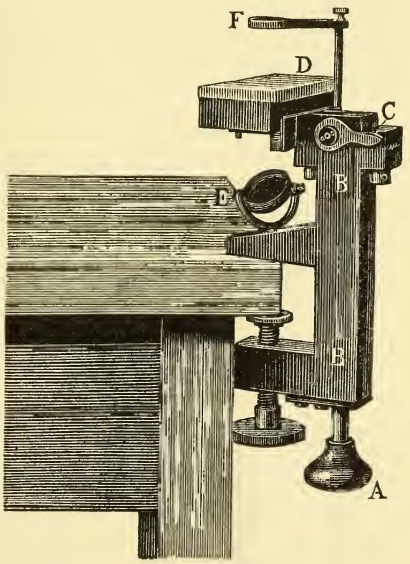
The arm carrying the cover-glass is raised and lowered by screw adjustment, and is held in position by a spring catch, but can easily be

turned aside. The arm moves parallel to the glass tablet, so that very small free-swimming animals can readily be caught and held fast between the two glasses. The thin cover-glass is cut off at the top, thus allowing reagents to be added to the drop of water while the animals are under examination ; it is much larger than the glass tablet and therefore allows the highest powers to be used all over the field and to the very edges of the glass tablet, which is of great importance in practical work. In nearly all other compressors the central part of the field can alone be reached with high powers. Messrs. Baker are the makers.

Air-pump for Microscopical Purposes.*—Dr. A. Koch describes an air-pump which has been used for many years at Göttingen, for removing air from microscopical preparations.

The apparatus consists of a vertical upright B B clamped on to the edge of the table. The upright is drilled out, and through the cylindrical passage runs a piston at the lower end of which is the handle A. The hollow in B B is in communication with the cavity of a rectangular box D, closed by a glass plate, and having cavity only just big enough to admit a slide. The lever C, when placed vertically, closes the communication between D and B B and opens another aperture which places B B in communication with the air. When placed horizontally the air space of D and the hollow of B B are connected. Then by putting down the handle A the air in the space D becomes rarefied and the bubbles are drawn out from underneath the cover-glass, as may be seen by means of the lens F and the mirror E. By alternately placing the lever C in the horizontal and vertical position and pulling down and pushing up the piston the preparation may be completely freed from air.

Fig. 47.



(4) Photomicrography.

Photography of Gratings and Micrometers engraved on Glass.†—M. Izarn, struck with the fineness with which the most delicate details of a plate on glass can be photographically reproduced, has made experiments on the photography of gratings and micrometers engraved on glass, and obtained reproductions so perfect that it is impossible at first sight to distinguish between copy and original. Twenty years ago Lord Rayleigh ‡ made experiments in the same direction, but abandoned

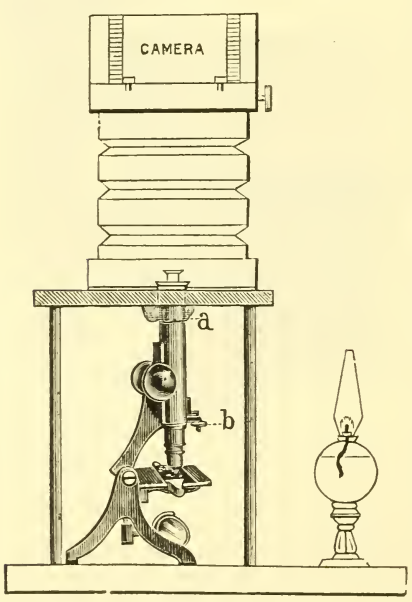
* Zeitschr. f. wiss. Mikr., ix. (1893) pp. 298-9 (1 fig.).
† Comptes Rendus, cxvi. (1893) pp. 506-8. ‡ Phil. Mag., 1872 and 1874.

them owing to the variability of the results obtained. He was also unable to produce a good *copie de copie*. The author, however, has succeeded in obtaining some which could scarcely be distinguished from the original model, and believes that it would be possible to push the reproduction still farther.

These successful results were obtained by means of the gelatin bichromate process. This photocollographic method also allows of successive gratings, placed in any position, being impressed upon the same plate of glass, for each proof can be treated as the original plate, and covered with a new layer of gelatin, and so on.

The technique of the process is simple. Solution of gelatin in the proportion of 1 gr. to 30 grs. of water, with addition of 0·10 gr. to 0·15 gr. of bichromate of ammonia, is liquefied over the water-bath and filtered through cotton-wool on to a plate of glass, which is then set up vertically and allowed to dry in the dark. The shutter in which the plate is exposed should be furnished with a chimney of stout black paper terminated by a cover which only admits the solar rays when the apparatus has been disposed in such a way that they fall perpendicularly upon the grating. With a good sun, the duration of exposure is from six to ten seconds. In diffused light, one to two hours may be required, but in this case the result is less satisfactory. After the exposure the plate is plunged into tepid water, then rinsed with cold distilled water, and, if necessary, brushed very lightly. It is well to protect with black paper all the part of the grating which is not engraved. To obtain a grating by reflection it is only necessary to substitute for the simple glass plate, a plate which has been previously silvered.

Fig. 48.



Camera for Microphotography.*—Mr. D. W. Barker gives the following description of his "home-made" apparatus (fig. 48). A wooden table is made somewhat wider around its top than the front of the camera, and contains near the centre an aperture through which the Microscope tube can project slightly. After removing the lens from the camera, place the latter on the table with its front downward. Place the Microscope underneath and close the aperture to rays of light by means of the small silk sleeve *a*. A good lamp is to be used for illuminating. Focus roughly by hand, and

* Amer. Mon. Micr. Journ., xiii. (1892) p. 39.

then finely on to the ground glass of the camera by means of the fine-adjustment screw *b*. Use a large diaphragm on the Microscope base. Expose in the ordinary way. A little practice will soon show the right exposure to be given, always using the same lamp. A small beading round the top of the table holds the camera firmly.

(5) Microscopical Optics and Manipulation.

Determination of "Optical Tube-length." *—The following paper on this subject was read by Mr. A. Ashe before a recent meeting of the Quekett Microscopical Club:—

"This is one of those practical matters the investigation of which many microscopists postpone indefinitely, and generally end by neglecting entirely, under the mistaken impression that its solution is involved in much difficulty, requiring an advanced knowledge of the laws of optics and a large amount of manipulative dexterity in order to arrive at a satisfactory result, and that even if a correct measurement can be made, the information so obtained is of no real value to the worker. The fallacy, however, of this latter view is so obvious, that it needs no refutation to any one who has taken the trouble to estimate the magnifying power of his own instrument.

To those who are content to accept the figures given in an optician's list as to the amplification of their various lenses, the following quotation from Mr. Crisp's well-known article † may carry some weight:—

'Microscopists have always recognized that the length of the tube of a Microscope is a factor in determining the amplification of the image, that the amplification is generally greater with a 10-in. tube than with one of 6 in., and that we obtain an increase of power by pulling out the draw-tube. Here, however, all exact notions as to the functions of the tube-length have practically stopped, so much so that there has not been any agreement even as to how the length of the tube is to be measured, whether from the front or back lens of the objective to the field-lens, the diaphragm, or the eye-lens of the eye-piece.'

Since these lines were written, now some eight years ago, it has come to be very generally admitted that the optical tube-length must be measured from the posterior principal focal plane of the objective to the anterior principal focal plane of the ocular.

But the question obviously arises, where are these focal planes situated, how are their positions to be located, and the distance between them estimated?

The desire for information on these points will certainly not be rewarded by any light the average microscopical textbook may throw on the subject, for, whilst laying stress upon the relationship existing between tube-length and amplification, they generally leave the reader very much to his own resources as to the methods employed in solving the former part of the problem.

A recent article in the Journal of the Royal Microscopical Society (1892, pp. 545, 546) on this subject is very interesting, but unfortunately the method suggested, whilst perfectly accurate and

* Journ. Quekett Micr. Club, v. (1893) pp. 152-4.

† This Journal, 1883, pp. 816-20.

thoroughly scientific, incontrovertible in its theory and capable of giving most excellent results in the hands of an expert, is yet, from its very nature, far too complicated in the details of its manipulation and abstruse in its mathematical principles to meet the requirements of the average worker, whose possession of apparatus is seldom of such an extent as to warrant his undertaking an optical research of no small magnitude, and who frequently hesitates to trust his conclusions to figures obtained by the exercise of a long-forgotten skill in the solution of algebraic equations.

Under these circumstances I beg to call your attention to a simple method of estimating the tube-length which will not involve the use of difficult formulæ or any apparatus beyond an ordinary stage micrometer.

It is based upon the increase in power obtained by extending the draw-tube through some measured distance, and is carried out thus:—

A careful estimate is made of the power of the Microscope with the draw-tube pushed home as far as it will go, then, having determined this, the eye-piece is withdrawn three or four inches, the exact amount being noted, and the increased power of the instrument remeasured.

We are now in possession of all the data necessary to calculate, not the actual optical tube-length, but its arithmetical equivalent, a distinction to be observed, though the difference is immaterial to the purpose in view.

As it is a rule in optics that the relative sizes of images formed by a lens at different points in its axis are in strict proportion to the distance of those points from the focus of the lens, we may arrange the following formula:—

$$\frac{A\,B}{C} = D$$

Where A = amplification of the instrument with the tube closed, where B = distance the ocular has been withdrawn, where C = increase in power produced by the effect of B. D is, therefore, the equivalent of the distance separating the focus of the objective from the anterior focal plane of the ocular.

To illustrate this simply, suppose an instrument magnifies 100 times, and that on withdrawing the eye-piece 3 in. the power is found to be increased 130 times, the equivalent of the tube-length will be by the above rule 10 in.

That it can be nothing else can be shown by the old Euclidean process of assuming it to be something else, and ascertaining how far this hypothesis agrees with observation, which of course, will end in a *reductio ad absurdum.*

The chief drawback of this proposed method is that it does not enable the worker to place his finger on any point on the tube and say with certainty, "Here lies the posterior focus of the objective and there the anterior focus of the ocular," but it faithfully gives us a figure which is the equivalent of the distance separating these two points, and this, after all, is the only concern of practical import.

In conclusion, I may point out that there is frequently an extraordinary discrepancy between the true optical and the actual mechanical tube lengths; thus in the case of an instrument in my possession a certain combination of lenses gave an optical tube-length of $4\frac{1}{2}$ in., whilst the

substitution of another objective in a much shorter mount increased the tube-length from $4\frac{1}{2}$ to $7\frac{1}{4}$ in., which, if not allowed for, would introduce errors amounting to 60 per cent. in the calculated powers.

Perhaps this may be considered an extreme case, but it serves to emphasize the importance to the microscopist of knowing something more about the optical length of his instrument tube than can be ascertained by comparing its outside dimensions with a foot rule."

(6) Miscellaneous.

Microscopy at the World's Fair.*—Mr. H. L. Tolman chose this subject for an address to the Microscopical Section of the Chicago Academy of Sciences. He said:—

"About eighteen months ago the Illinois State Microscopical Society decided to make a representation at the coming Columbian Exposition, and appointed a committee of three, consisting of Dr. L. D. McIntosh, Mr. C. O. Boring, and myself, to solicit exhibits. On the death of Dr. McIntosh Mr. W. H. Summers was appointed in his place. The design of the Society was to take the requisite space at the World's Fair and then ask all the Microscope makers in Europe and the United States to make a display of their productions, and also, if possible, to get exhibits of mounted slides, &c., from various workers in different departments of science. I spent last summer in Europe, and as chairman of this committee, and also as member of a similar committee appointed by the American Microscopical Society, I visited all the leading European Microscope makers, with one or two exceptions, and was very much pleased to see the interest they took in the matter. Several said they would rather make an exhibit in such a scientific display than in the commercial department, and it is probable that nearly all will be represented. In fact, it is safe to say that the exhibit of modern instruments and accessories will be the most extensive that has ever been made at any world's fair.

In regard to a display of old instruments, unfortunately nothing could be accomplished. There are only three large private collections of Microscopes in Europe. By far the largest and finest, not only in England, but in the world, is that of Mr. Frank Crisp, a prominent and wealthy London solicitor. It contains over 2000 Microscopes, besides a very large number of substage attachments, condensers, micro-spectroscopes, live-cages, mechanical stages, polariscopes, objectives and other accessories, which give an accurate history of the Microscope and its development. An evening spent with Mr. Crisp and his collection is one long to be remembered. Many of these instruments are very fragile and complex, not a few are unique, and it would be impossible, without great time and expense, to box and ship them anywhere. Some, on account of their fragility and complexity, could not be transported at all, and hence Mr. Crisp said he felt compelled to decline even to attempt to send his collection to Chicago.

The next largest collection is that of Mr. Nachet, the well-known Paris Microscope maker, and it also contains some beautiful and rare instruments. Among others he has a unique specimen of the first known

* Amer. Mon. Micr. Journ., xiv. (1893) pp. 15–6.

binocular telescope, and an unexampled collection of simple Microscopes in gold or silver engraved cases. Dr. H. Van Heurck, of Brussels, one of the most able and enthusiastic microscopists living, has also a fine selection of old instruments; but both of them, like Mr. Crisp, were unwilling to allow their treasures to be subjected to the dangers of a long journey. The Society will therefore be compelled to fall back on the collection in the Army Medical Museum at Washington, which, it is hoped, the Government authorities will bring here for exhibition.

The exhibit of the Society ought to be of a good deal of interest, for in some senses it may be said that microscopy has reached its acme. Prof. Abbe says that it is not probable that any glass will be discovered of higher refractive index than that known, and without that it is not possible to construct lenses of much higher power or angle than at present. Our present objectives, then, are nearly perfected, unless future investigations show our theory of light to be erroneous. In regard to Microscope stands, there are a large number of forms for different purposes, many very attractive. Klönne and Müller, of Berlin, manufacture one of the Zeiss form wholly of aluminium, except the foot. Those who will exhibit, so far as they have already consented, are Baker, Swift, Crouch, Beck and Beck, and Powell of London, Klönne and Müller of Berlin, Zeiss of Jena, Hartnack of Potsdam, Reichert of Vienna, and probably Nachet of Paris and Leitz of Wetzlar.

One of the pleasant features of the exhibit will be that, by express permission of the manufacturers, the Committee of the Society will be allowed to show the various stands and objectives at the meeting of the Society or at such times and places as may be agreed on, so that all microscopists will have an opportunity of seeing the best foreign work, and comparing it with that done in this country. The domestic manufacturers will not be behind in their display, and they have already taken the necessary steps to be seen. Dr. E. Cutter, of New York City, has consented to allow his famous Tolles 1/75 to be exhibited. The space assigned to the Society by Prof. Peabody, the chief of the department of Liberal Arts, is in the south gallery of the Liberal Arts Building, next to the astronomical and photographic exhibits, and close to the commercial displays of Bausch and Lomb, Queen and Co., Zeiss and others, and is in a very advantageous part of the building."

β. Technique.*

(1) Collecting Objects, including Culture Processes.

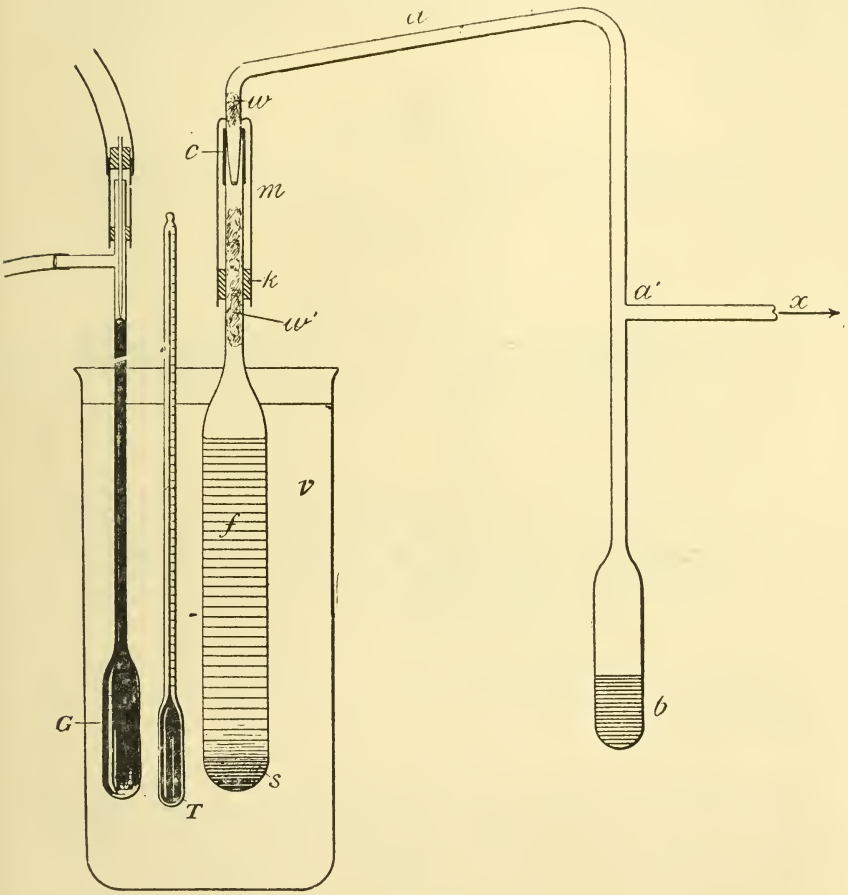
Apparatus for Cultures in Vacuo.†—In the course of his researches on the ginger-beer plant Prof. H. M. Ward found it necessary to cultivate in vacuo, and with the aid of Prof. McLeod devised the following apparatus:—*a a'*, glass tubing attached to mercury pump beyond *x*; *b*, bulb for condensed vapour; *w* and *w'*, cotton-wool plugs, the former in *a*,

* 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.

† Phil. Trans., vol. 183 (1892) pp. 125-97; figs. 49-51 by permission of the Royal Society.

the latter in the neck of the cultivation flask *f* which contains the medium and growing culture *s*; *c*, caoutchouc tubing connecting the tubes *a* and *f*; *k*, cork ring, and *m*, a glass tube filled with mercury so as to make a gas-tight junction over *c*; *v* is a glass beaker containing water; this is placed over a small burner in connection with the gas regulator G; T, thermometer. The various pieces of the apparatus having been carefully

FIG. 49.



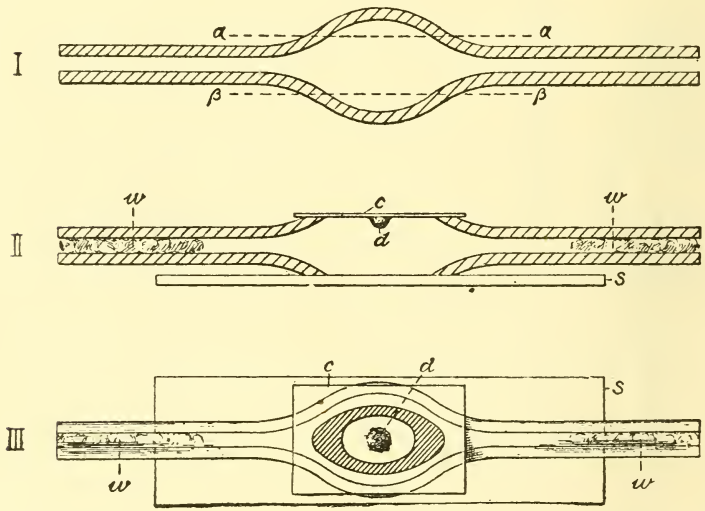
sterilized the tube *f* is filled with the cultivation medium, the neck plugged with cotton-wool and the whole kept at 80–90° C. for several hours on at least three successive days. The medium is then infected and the whole apparatus connected up. The air is exhausted by means of the mercury pump and the gas developed by the culture removed from time to time. This is absorbed at once by potassic hydrate.

The defect of the apparatus appears to be that the medium must alter in composition from the constant and gradual loss of fluid by evaporation, though in other respects its working seems favourable.

Glass Culture-chamber for Hanging Drops.*—In his researches on the ginger-beer plant, Prof. H. M. Ward used the following simple form of apparatus for cultivating organisms in hanging drops and in various gases under the Microscope.

The chamber itself is made out of a piece of stout glass tube about 3 inches long and as thick as possible; this is drawn out carefully at both ends until it looks like fig. 50, I. The narrow tubes must not be

Fig. 50.



I. Tube ready for grinding, the glass being ground down to the levels $\alpha\,\alpha$, $\beta\,\beta$.
II. Side view of chamber ready for use.
III. View of same from above. *c*, cover-slip; *d*, hanging drop; *w*, cotton-wool plug; *s*, glass slide.

drawn thin, but the glass should be softened and allowed to contract the opening. The incomplete instrument now looks like a narrow tube with a bulb at its middle. The upper and lower faces are now ground parallel until the sides are perforated by circular or oval apertures.

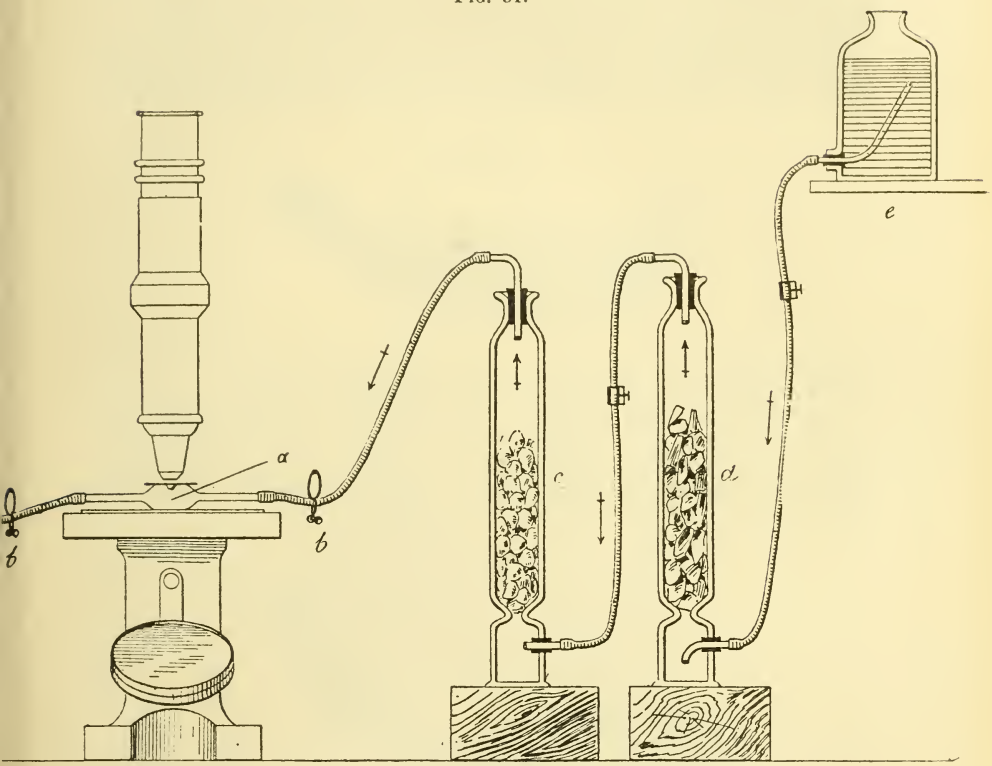
After sterilizing, the lower aperture is closed by fixing its edges with melted paraffin to a sterilized glass slide. The upper aperture is closed with a cover-glass fixed on with freshly boiled oil, and the two end tubes are plugged with sterilized cotton-wool.

The apparatus may be used as it stands for hanging-drop cultivations in air, or, by connecting it with a gas-generator, the cultivation

* Phil. Trans., vol. 183 (1892) pp. 128–97 (5 pls.).

may be carried on in any atmosphere. In fig. 51 is seen the apparatus arranged for cultivations in an atmosphere of CO_2.

Fig. 51.



a, culture chamber, with hanging drop, in position on Microscope stage.

b b, brass clips on caoutchouc tubes attached to plugged tubes of culture chamber.

c, washing apparatus, through which the gas generated in *d* passes before going into culture.

e, vessel containing dilute HCl, for evolving CO_2 from the marble in *d*.

Apparatus for setting Gelatin.*—Dr. L. Heydenreich describes an apparatus which he uses for setting gelatin or agar in flasks or test-tubes just removed from the sterilizer. It consists of a square tin box, 30–40 cm. long, 20 cm. broad, and 20 cm. high. On the broad side are 6 openings, placed one above another, and each with a diameter of about 1 cm. A stream of water is passed into the box, and the water passes out through the lateral openings, any of which may, if necessary, be corked up.

In this way gelatin or agar is rapidly set; large flasks of hot gelatin

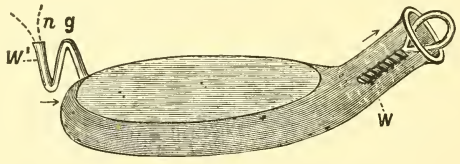
* Zeitschr. f. wiss. Mikr., ix. (1893) pp. 309–11 (1 fig.).

can be consolidated in 15–20 minutes. Care must be taken that the glass is not cracked by using the water too cold at first.

Simple Method for Anaerobic Cultivations.*—Dr. O. Roth has used for some time a glass vessel (fig. 52), having considerable resemblance in shape to a bed-pan, for cultivating micro-organisms anaerobically.

The little tube *g* is N-shaped, and placed laterally, a position which prevents the gelatin from escaping when it is poured in during sterilization. Both openings, W and W′, are plugged with cotton-wool. The

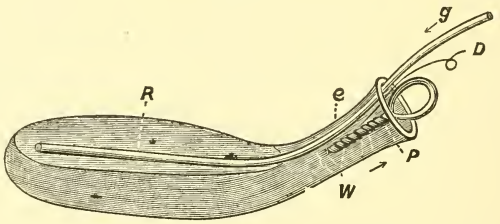
Fig. 52.



former is attached to a wire corkscrew and the latter to a wire loop, so that the plugs can be pushed in or withdrawn with facility.

When the necessary quantity of gelatin (8 cm.) has been poured in, discontinuously sterilized and inoculated, the gas is introduced through the tube *g* and passes out at the neck W. When all the air has been expelled and sufficient gas supplied, the neck is hermetically closed with melted paraffin, and the small tube *g* is similarly treated.

Fig. 53.



For water-examination, the angular entrance-tube *g* is replaced by a curved metal pipe introduced into the flask through the neck (fig. 53). The air is removed after the return to the laboratory. At *e* the pipe is expanded, and just below the swelling is fastened a piece of fine copper wire for the purpose of easily withdrawing the pipe. The gas is introduced through a caoutchouc tube fixed to the free end of R, and when the air has been quite replaced, the neck is plugged with paraffin, the caoutchouc tube being withdrawn while the paraffin is still hot.

For cultivations in fluid media wherein a considerable amount of gas is disengaged, the following plan is suitable.

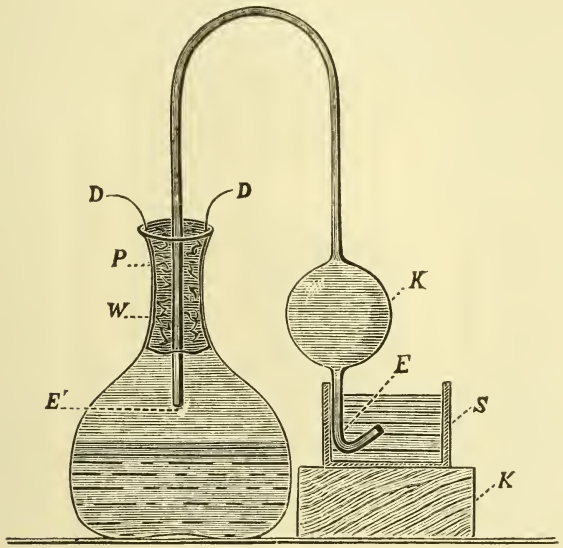
A flask (fig. 54) of any convenient size is stopped with cotton-wool, through the middle of which passes a bent glass tube, near the other end of which is a bulb K, and the extremity is turned up at angle E.

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 223–7 (3 figs.).

At present the cotton-wool is only lightly pressed into the neck and now the flask is dry-sterilized. This done, the flask is about half-filled with the liquid medium and then thrice (discontinuously) steam-sterilized.

The medium is next inoculated, and the end E′ of the tube is pushed down until it nearly touches the bottom of the vessel. Hydrogen is then introduced at the E end in the usual manner, and it passes through the medium, to escape through the cotton-wool plug.

Fig. 54.



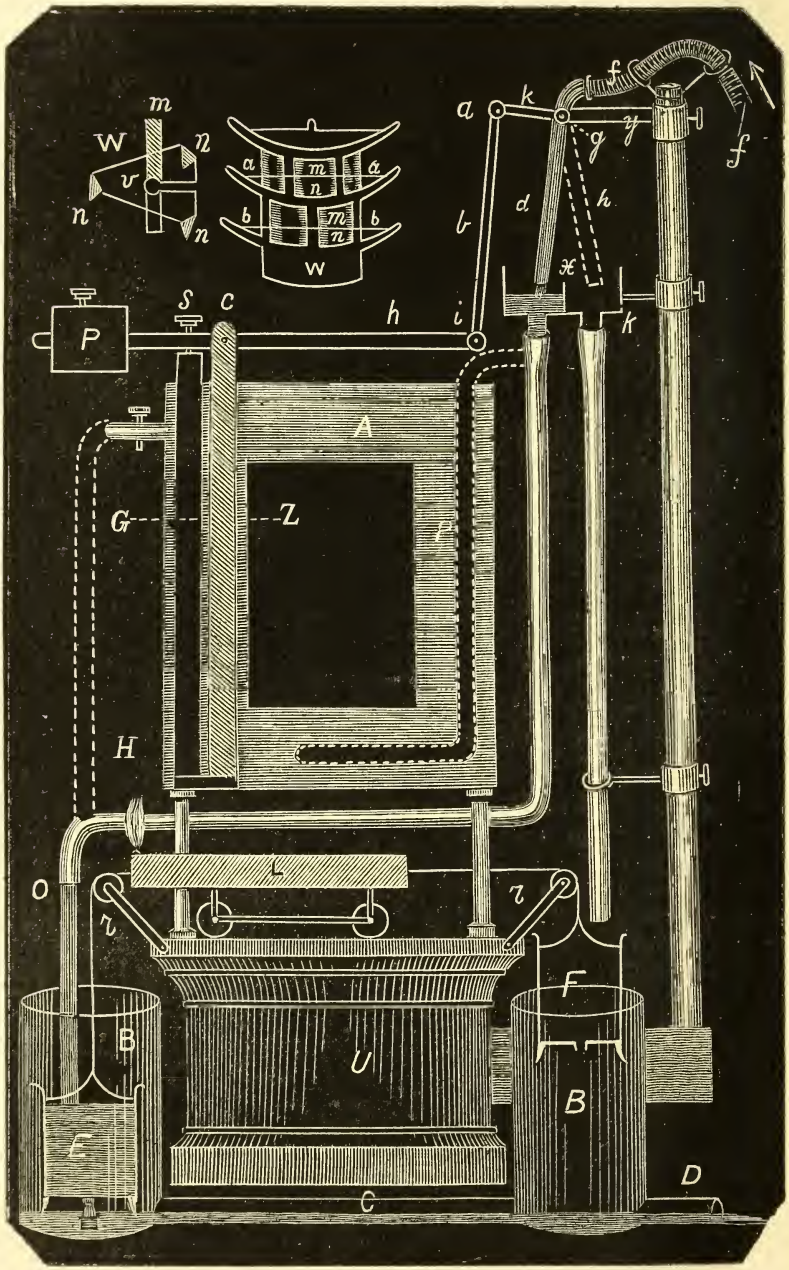
After some time the glass tube E E′ is drawn up to the position indicated in fig. 54, and under the E end is placed a vessel containing glycerin and supported on a wooden block.

When all the air has been driven out of the flask, the neck is filled with paraffin P, and the caoutchouc tube from the gas-generator removed from E. Thus air is prevented from getting into the apparatus by the paraffin at one end and the glycerin at the other. The bulb K is to prevent the glycerin (which is preferable to mercury, as this sometimes damages the copper parts of the incubator) from running up the tube. When necessary, the cotton-wool plug is easily withdrawn by gently heating the neck of the flask.

Self-regulating Constant Incubator.*—Prof. L. Landois describes an incubator, the chief merits of which are that it is quite free from danger, and that it requires for its construction materials such as are to be obtained anywhere. The source of heat is a mineral oil lamp or a specially made stearin candle, so that both gas and electricity are dispensed with (fig. 55).

* Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 256-62 (1 fig.).

FIG. 55.



PROF. LANDOIS' INCUBATOR.

The incubator A is a doubly-walled chest of tin covered with felt, supported on a convenient stand U. The lid, not shown, is also double, and lined with some badly-conducting material. Under the incubator runs a trolly L, which carries the source of heat H. The trolly is made to run to and fro by means of the varying differences in the weight of water in the pails E and F, for when E is full its weight drags the trolly into the position in the illustration, and conversely. Both pails are filled from a stream of water at *o* or *w*, and at the bottom of the pails is a small hole for the water to escape, the outflow stream being, of course, less than the inflow. The result is that as the water cools, the stream ceases to run from *o* and begins to flow in from *w*, the pail F fills and E empties. Hence the trolly is pulled over towards F. The stream of water is regulated in the following manner:—G and Z are two vertical rods—the former of glass, the latter of zinc—joined together at the lower extremity. To the top of Z is connected at *c* the horizontal metal arm *h*, at the end of which is a running counterpoise P. The arm is attached to the glass rod G by the screw *s*, and as the two rods G and Z expand unequally, the zinc rod becoming longer as the heat of the water increases, and *vice versa*, so the metal arm *h* rises or falls. The arm *h* is connected by jointed metal pieces with the water supply, represented in the illustration at *d* and *e*. The position given is where the zinc rod is elongated, the lever has risen, the water stream has been diverted to the pipe *o*, and the heat cut off. When the temperature sinks, the water returns to the position *e*, passing to the pipe *w*. The water stream passes into a box *k* divided by a low partition into two compartments, one of which is in connection with the heating side, the other with the cooling side of the apparatus. B B are receivers connected by a pipe C at the bottom for the overflow to escape at D.

Although the apparatus can be heated with any flat mineral oil lamp placed on the trolly, the author gives the preference to a stearin light, the directions for making which are given, as bought stearin candles are unsatisfactory. The wick fits into a special lighting apparatus made of tin W, and this carries three superimposed pans for catching the melting stearin. The wick is made of reed (*Arundo phragmites*) cut up into pieces 15 cm. long and 1 mm. thick. These pieces, which must be perfectly straight, are boiled in a mixture of equal parts of saturated saltpetre and borax solutions. While still moist they are wound round with three threads of soft, fine, six-strand cotton. Thus prepared, the wicks are again boiled in the solution and afterwards dried in an oven.

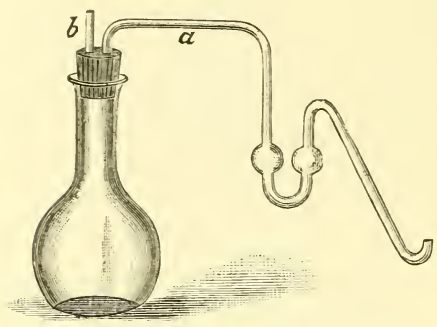
Stoppings and Aerating Arrangements for Pure Cultivations.*—Dr. A. Koch describes an improvement in the arrangements for collecting gases derived from pure cultivations. It consists of a flask (fig. 56), the caoutchouc stopper of which has two perforations. Through one of these passes a U-tube *a*, on which are one or more bulbs. The bulbs are filled with 1 per cent. sublimate or dilute H_2SO_4, &c. The tube *b* is simply a short piece of glass tubing filled with cotton-wool. The caoutchouc stopper is tied firmly on to the neck, the flask filled with the cultivation medium, and the whole sterilized. After sterilization the joints and spaces about the stopper are covered with a mixture of

* Centralbl. f. Bakteriol. u. Parasitenk, xiii. (1893) pp. 252-6 (3 figs.).

2 parts paraffin and 1 part caoutchouc. When the medium is cold it is inoculated by means of a freshly made capillary tube and introduced through the short tube *b*, after which the latter is at once sealed up. In order to collect the gases formed, the end of the tube *a* is immersed in mercury and covered with a eudiometer.

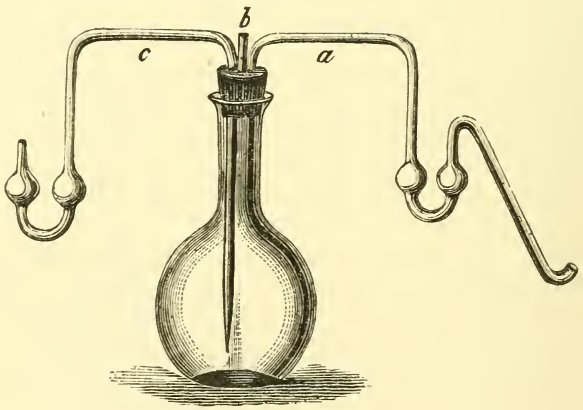
By the foregoing arrangement only a moderate amount of oxygen remains in the flask, and this is soon expelled or replaced by the fermentation gases. If it be desirable to fill the apparatus with hydrogen for anaerobic cultivation, all that is necessary is to connect the *a* end with a hydrogen-forming apparatus directly after sterilization while everything is hot, for as the apparatus cools down it gets filled with hydrogen.

Fig. 56.



It is sometimes necessary to supply air to cultivations, and this may be done by the arrangement shown in fig. 57. In this stopper are three holes, two of which are fitted as in fig. 56, while the third hole is for the passage of a U-tube, one leg of which reaches nearly to the bottom of the flask and is drawn out to a point; on the other end are two bulbs filled with some antiseptic fluid. The air is better forced in at *c* than sucked in at *a*. For this purpose a couple of

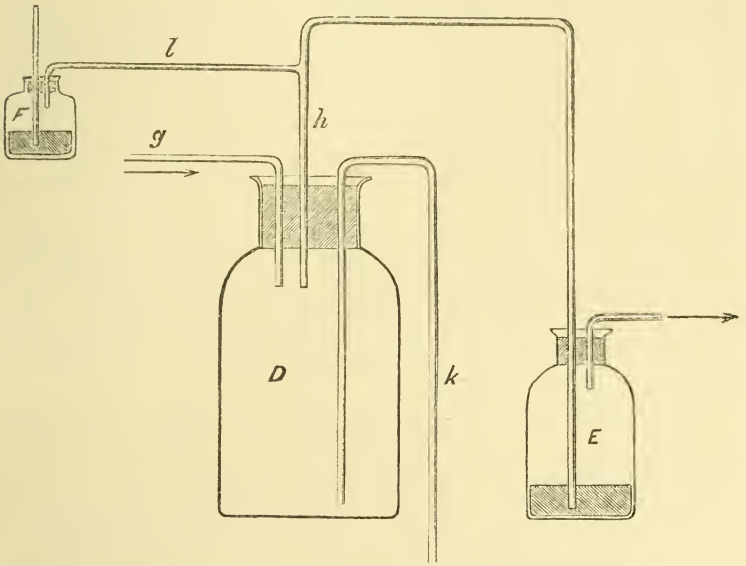
Fig. 57.



large flasks are placed in connection with each other and the tube *c*; one flask, placed higher than the other and containing water, forces by the fall of the water the air from the second flask through the tube *c*. When one flask is empty the positions are reversed.

This arrangement answers very well for a short time, but if the cultivations require to be supplied with air for a long time an automatic arrangement becomes necessary. In fig. 58 such an arrangement is given. It consists of a flask D, closed by a triply-perforated stopper; into this water slowly and continuously runs through the tube *g* and drives

Fig. 58.



through *h* the air in E to the culture through the tube *i*. When, however, the vessel D gets so full that the water rises as far as the level of the letter *h*, then the siphon action of *k'* comes into play and D is emptied in a few minutes. Air is sucked in through *l* to *h*, and when D is empty the water running through *g* goes on driving the air through *h* to E.

As a matter of course, the aerating apparatus is adapted not only for fermentation cultivations, but for any kind of culture.

Plate-making.*—Dr. L. Heydenreich, after pointing out that he was the first to introduce the double capsule, though Petri got the credit of it, says that when several (6–10) have been filled with the necessary quantity of gelatin or agar they are placed on a Koch's levelling tripod, the plate of which is made of metal instead of glass. On the top of this is placed a flat pan filled with ice, a procedure which materially shortens the time required for setting the plates.

The special advantages of a metal plate for the purpose alluded to are obvious, but a perfect plane sheet of brass sufficiently thick not to bend is somewhat costly. A thin sheet of metal backed with wood, however, answers the purpose quite well.

* Zeitschr. f. wiss. Mikr., ix. (1893) pp. 306–9 (1 fig.).

The author then alludes to devices for preventing agar plates made in these double capsules from drying. Into the upper capsule or cover is inserted a semicircle of moistened sterilized filter paper. All the colonies can be seen if the cover be turned round. But gumming up the interspace between the capsules, or putting a layer of paraffin or vaselin along the edge, answers the purpose very well.

Method for Finding the Exciting Cause of Vaccinia.*—Dr. Siegel mixed 1–2 grm. of animal lymph with distilled water and injected the mixture into the peritoneal sac of calves and goats. There were no febrile or other symptoms. The animals were killed in from 4–8 days. The peritoneum, and especially the mesentery, was covered with a fibrinous, easily detached deposit, besides which there were numbers of small nodules on the peritoneum, swelling of the mesenteric lymphatic glands (from inflammation and hæmorrhage) and of the liver, parts of which were softened. Blood-serum tubes inoculated from the glands and liver developed in two or three days colonies of a bacillus, the length of which exceeded the breadth only by a little. Gelatin was not liquefied, and in puncture and stroke cultivations the colonies spread from the inoculation track all over the surface like a transparent veil. Micro- and macroscopical appearances of disease were found in a goat after peritoneal injection, but inoculations of mice, guinea-pigs, rabbits, and pigeons were without result.

Eight adults and three infants were then inoculated. Redness and some swelling resulted, and these passed off by the fourth day. After a lapse of fourteen days all these persons were inoculated with fresh effective lymph. The three children and one adult took. The author concludes that the vaccine bacteria lost virulence from growing on an artificial medium, so that while the lymph was able to protect some who had been previously vaccinated, it was useless to the more sensitive children.

Incoagulable Albumen as Cultivation Medium.†—M. E. Marchal has used with success for the cultivation of pathogenic and saprophytic bacteria, albuminous solutions prepared in the following way. Fresh white of egg is diluted with distilled water; it is then filtered. To the solution sulphate of iron 1-1000 is added in the following proportions:—Solution of white of egg 1–5 per cent., add 1–5 ccm. the litre; solution of white of egg 5–10 per cent., add 5–10 ccm.; solution of white of egg 10–15 per cent., add 10–15 ccm. The ferrous sulphate has the curious property of preventing heat from coagulating the albumen. The solutions may be sterilized at 115° and are perfectly limpid with a slightly alkaline reaction.

New Method for Preparing Gelatin.‡—Drs. E. Acosta and F. Grande Rossi recommend the following procedure for preparing nutritive gelatin on the ground that no filtering apparatus is necessary, that the necessary quantity of gelatin can be quickly prepared, that it is firm, transparent,

* Deutsch. Med. Wochenschr., 1893, p. 29. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 291–2.

† Bull. Soc. Belge de Microscopie, xix. (1893) pp. 64–5.

‡ Crónica Médico-quirúrgica, 1892, No. 14. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 207.

and suitable, and that much time is spared. One kilogramme of meat freed from fat, &c., is cut up into small pieces and immersed in double its weight of water. It is then boiled, skimmed, strained, and replaced on the fire; 0·5 per cent. of pepton and 0·25 per cent. of sodium chloride are added. The original bulk is restored by adding water, and 16–18 per cent. of gelatin is put in. The solution is then placed in a porcelain or glass vessel, twice as high as it is broad, and kept in a Chamberland's autoclave for a quarter of an hour at 105°, and under 1/2 atmospheric pressure. The gas is then turned off and the solution allowed to stand. After the lapse of twenty-four hours the vessel is removed from the stove, and the solidified gelatin, set free with a knife, is placed upside down on filter paper. The top, in which all the impurities have deposited, is then cut off with a thread or wire, and the rest is cut up and the pieces put into a flask and boiled. When liquefied it is distributed into test-tubes, &c., and these are afterwards sterilized discontinuously.

Method for Cultivating Tubercle Bacilli.*—Sigg. Morpurgo and Tirelli made little chambers or boxes of celloidin by moulding the material on blocks of unequal size. The chambers were sterilized by boiling, and then pieces of tuberculous organs placed inside. The little tubes were then filled with cell-free serum by inserting them under the skin, or in the abdominal cavity of a rabbit. After some days small white flecks were seen collected at the bottom of the tube, and these consisted of tubercle bacilli, as was proved by inoculation and cultivation. In tubes similarly prepared, but not placed inside an animal, the bacilli were not found to increase. Some of the boxes placed under the skin excited suppuration, while those placed within the abdominal cavity had no prejudicial effect on the animal's health, even after two months. It seems possible that this method might be useful for cultivating organisms which at present have not been successfully reared on artificial media.

Simplification of Method for Diagnosing Diphtheria.†—Dr. N. Sákharoff proposes as a cultivation medium for diphtheria egg-albumen instead of coagulated blood-serum. Fresh eggs are hard boiled and then shelled. The white is then cut up into longish pieces and these placed in test-tubes in the bottom of which is a little water in order to prevent the albumen from drying. On this medium at 35–40° the diphtheria bacilli appear in twenty-four hours as small round convex colonies.

Simple Apparatus for Collecting and Preserving Pus, Blood, &c., for Microscopical or Bacteriological Work.‡—Dr. von Lagerheim has devised a simple apparatus for the collection, preservation, and transportation in a sterile condition of pus, blood, vaccines, &c. A test-tube is stopped with a doubly perforated cork. Into one hole is inserted a

* Arch. Ital. de Biologie, xviii. p. 187. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 74–5.

† Ann. Inst. Pasteur, vi. (1892) No. 6. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 143–4.

‡ Annales de la Universidad Central del Ecuador, ser. vii. No. 48, 1893, Quito. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 501–2.

tube, the lower end of which is drawn out to capillary size. The upper end is plugged with cotton-wool and can be fixed to the cork by means of paraffin. The second hole, closed with cotton-wool, is merely intended to allow the air to escape when the cork is pushed in, and so prevent it from being forced up the capillary tube.

After sterilizing the test-tube in the flame, the capillary is also sterilized with sublimate, alcohol, and sterile water by sucking these reagents through, and the apparatus is then ready for use.

The material to be collected is obtained by inserting the capillary in the fluid, and then sucking it up, The cork and the tube are then replaced in the test-tube. If it be desired to prevent the germs in the material in the capillary tube from multiplying, small pieces of ice can be placed on the bottom of the large tube and the whole packed in wadding.

New Method for the Culture of Diphtheria-Bacilli in Hard-boiled Eggs.*—Dr. Wyatt Johnson writes :—" All who have had experience in the diagnosis of diphtheria by culture methods agree in praising their accuracy and promptitude. Unfortunately, the general practitioner, who must feel most of all the need of some accurate method for the prompt diagnosis of doubtful cases, does not seem disposed to avail himself of the new process, and the prophecy of Roux and Yersin, that the method would come into general use, appears still to be far from fulfilment.

Thinking that the chief obstacle lay in the difficulty of obtaining serum for the culture medium, M. Sakharoff † recently suggested a simple plan by which slices of hard-boiled eggs, cut with a sterilized knife and placed in sterilized tubes, could be made to replace the serum. Of this method I have no personal experience, but should imagine that the main objection would still exist, as the physician might not have test-tubes about him at the time when they were most needed.

I have, during the past two months, made use of a method which may be regarded as a modification of Sakharoff's, and which does away with the necessity both of test-tubes and the preparation of media before they are actually needed for use.

I employ hard-boiled eggs from which a part of the shell is removed with ordinary forceps, after being tapped so as to break it. In this way shell and shell-membrane can readily be peeled off from one extremity (by selecting the narrow extremity the air-chamber is avoided), leaving a smooth, glistening, moist surface, which offers a most tempting spot for making cultures. These are made, as in case of serum, by touching the diphtheritic exudation with a sterilized needle and drawing the latter lightly from three to six times across the exposed white of the egg. Instead of the regulation platinum needle mounted in a glass rod, I employ either an ordinary needle or a bit of silver suture wire held in an artery forceps. To guard the culture against contamination the egg has only to be placed upside down in a common egg-cup. It can afterwards be wrapped in paper and transported if necessary. The interior of the cup can be sterilized, if desired, by allowing a flame to enter it for a

* Micr. Bull. and Science News, ix. (1892) pp. 42 and 3.
† Ann. Inst. Pasteur, June 1892.

second or two, though I have not found this necessary, as the nutrient surface does not come in contact with the inside of the cup. The egg and shell are, of course, both sterilized by the act of boiling. Five minutes' boiling suffices, and if the operation has to be done 'while you wait,' the egg can be cooled in a still shorter time by placing it in cold water. Strict attention to aseptic details is unnecessary as the diphtheria bacillus outstrips in its growth the contaminating organisms likely to lead to confusion. The appearance of the diphtheria colonies at the expiration of twenty-four hours is the same as when they are grown in serum, but I have found the growth even more rapid, so that a colony is already visible in twelve hours. Confusion with micrococci is, of course, to be guarded against. The reliability of this method seems to be the same as that of the methods of Haffter and E. Roux. I have found one bacillus which attains visible dimensions within the same period, but, as this also grew on in the manner characteristic of the diphtheria bacillus, the great value of the method here described is not invalidated by that fact.

Although this minor modification of a now well-tried procedure might enable it to be employed by those destitute of laboratory outfits, I do not think it likely that this means of diagnosis will be utilized by physicians not habituated to laboratory methods.

It may be of interest to state here that the constant temperature of about 35° C., needful to ensure the rapid and characteristic growths of diphtheria bacillus, can readily be obtained by placing in a cupboard or box with the culture a large jar or pail of warm water, which is renewed from time to time, thus making an impromptu thermostat."

(2) Preparing Objects.

New Method of Preparing Spinal Cord.*—Dr. E. Goodall recommends a new method for preparing the spinal cord for microscopical examination, the chief steps in which are:—Place a portion of a cord taken from a recently killed animal, and 6 to 8 mm. high, on the ether freezing microtome; free and cut; float the section, which should be quite free from wrinkles, on to water; take up the section as soon as possible with a perforated lifter, drain off excess of water, and float the section on pure piridin kept at hand on a watch-glass. One quarter of an hour to one hour will probably suffice. Wash well in water; stain; dehydrate and clear in piridin; mount in balsam suitably thinned with piridin. Anilin blue-black (1/4 per cent. aqueous solution) followed by picrocarmine may be recommended as a staining reagent.

New Method of Preparing Dentine.†—In this method, suggested by Lepkowski, it is stated that sections of bone or dentine may be simultaneously softened and stained. The agent used is a modified form of Ranvier's fluid, and is composed of 6 parts of a 1 per cent. watery solution of gold chloride to 3 parts of pure formic acid. The pieces of teeth, which should be 1/2–3/4 mm. thick, are placed in this fluid for 24 hours; they are then removed, washed with distilled water, and placed in a mixture of gum arabic and glycerin for 24 hours. On

* Brit. Med. Journal, May 1893, pp. 947 and 8.
† Journ. Brit. Dent. Assoc., xiv. (1893) p. 248.

removal from this last reagent they are again washed with distilled water, then alcohol, after which they are imbedded in celloidin or paraffin.

Preserving Larvæ of Crinoids.*—Dr. O. Seeliger found that of the various methods by which he preserved the larvæ of Crinoids, sublimate solutions were the best; not only was the external form truly preserved, but the histological details were in a good state. In the later stages, when calcareous plates begin to be deposited, these solutions could not, of course, be used. For the cleavage stage, 1/50–1/60 part of concentrated acetic acid may with advantage be added to the sublimate; the addition of 1/10 per cent. chromic acid made the embryos rather brittle, and they stained less well than when it was not used. To preserve the calcareous plates, absolute followed by 80 per cent. alcohol should be used.

Almost all the embryos and larvæ were stained slightly before imbedding in borax-carmine; this makes them more easily visible, and notwithstanding their small size they are not so easily lost in paraffin. The sections were most satisfactorily stained with Grenacher's acetic hæmatoxylin solution; if they colour too deeply they should be placed in weak acid alcohol. Some observations were also made on teased preparations.

Demonstration of Living Trichinæ.†—Dr. A. S. Barnes recommends that a piece of trichinized muscle, about the size of a pea, be placed in a small bottle, containing a solution of 3 grains of pepsin, 2 drachms of water and 2 minims of hydrochloric acid. If this be kept at the temperature of the mammalian body, and the fluid be now and again shaken, the meat will, in about three hours, be dissolved, as will also the cysts which contain the Trichinæ. The fluid is next to be poured into a conical glass, so as to allow the Trichinæ to settle at the bottom. They may then be drawn out by a pipette, and the contents placed in a large glass cell. Put the cell under a dissecting Microscope; pipette out the Trichinæ and place them in clear water. Again pick out the worms and place in a drop of pure water in the centre of a glass cell or live-box. Put on a cover and seal with white vaseline. Examine on a hot stage. If a permanent mount of isolated worms be wanted, use a drop of glycerin instead of water.

Observing and Dissecting Infusoria in Gelatin Solution.‡—The procedure adopted by Mr. P. Jensen consists in placing the organisms in a weak solution of gelatin. A 3 per cent. solution is the most satisfactory, and this is made by dissolving 3 grm. gelatin in 100 ccm. of water with gentle heat. At a temperature of 18° to 19° C. this solution sets to a firm jelly. The solution can be kept in a flask stopped with cotton-wool, or, better still, after sterilizing thrice at about 80°. Large infusoria, like *Paramecium aurelia* and *Urostyla grandis*, when immersed in this jelly and placed under a cover-glass, no longer move. If the jelly be thinned down by adding an equal bulk of water, it becomes

* Zool. Jahrb. (Anat. u. Ontog.), vi. (1892) pp. 168–72.

† Amer. Mon. Micr. Journ., xiv. (1893) p. 104.

‡ Biol. Centralbl., xii. (1892) p. 556. See Zeitschr. f. wiss. Mikr., ix. (1893) pp. 483–5.

tremulous and movements are not much impeded. If the Infusoria are to be dissected the gelatin should be thinned down from 0·8 to 1·0 per cent. In order to transfer the animals to the gelatin, the latter is warmed until it is just liquefied. A small quantity of it is poured into a watch-glass, a drop of water containing the animals is added to it, the two stirred quickly together, and a drop of the mixture placed on a slide (which may be ever so slightly warmed), and then the cover-glass at once put on. If it be desired to keep the Infusoria for some time in this gelatin it is well to make the preparation with the water which they inhabit, so that the Bacteria on which they live may be present for their nutriment.

Weaker solutions of gelatin are not at all harmful to the organisms: e.g. the author has found *Paramecium aurelia* and *Euglena viridis* multiply wonderfully in a 0·5 per cent. solution. Stronger solutions set up a gradual granular degeneration, though in these the animals will remain unaltered for 3 hours, quite long enough for observations. *Euglena viridis* has, however, been kept for 24 hours quite motionless in strong jelly, and, after having been dissolved out with warm water, became quite lively again.

Demonstrating Structure of the Embryo-sac.*—Mr. G. W. Martin has found the following process useful for demonstrating the egg-apparatus and antipodal cells in *Solidago* and *Aster*. The material was fixed in 1 per cent. chromic acid for twenty-four hours, and stained with alum-carmine after washing; again washed and dehydrated; it was taken through the xylol-absolute-alcohol process into a saturated solution of xylol and paraffin; it was then infiltrated with paraffin, imbedded, and cut with a microtome; the sections were stained with Bismarck-brown and mounted in xylol-balsam.

Giant Cells and Phagocytosis.† — Dr. Knud Faber devised a method whereby he was able to demonstrate most convincingly that giant cells are intracellular digesting phagocytes; the method consists in introducing into the subcutaneous tissue of rabbits gelatinized agar and then observing the resorption processes. The agar was dissolved in distilled water; usually a 1½ per cent., but occasionally 3 per cent. solutions were injected, and immediately afterwards the injection site was cooled down with an ether spray so that the mass set *in situ*. It was then left for periods varying from 1 to 80 days.

In no case were there any naked eye evidences of inflammation, the agar lying apparently unchanged, imbedded in the connective tissue.

The pieces excised for microscopic investigation were fixed usually in Flemming's fluid or in spirit, but sometimes in sublimate or picric acid. The stains used were safranin, alum-carmine, gentian-violet, and hæmatoxylin. The appearances observed were those of chronic inflammation, the pieces of agar being surrounded by leucocytes, epithelioid and giant cells. The agar pieces were not only surrounded by cells but were found within the cells. By colouring the agar with carmine or Berlin blue the digestive action of the giant cells was best seen. The opinion is strongly expressed that giant cells possess in a special degree the

* Bot. Gazette, xvii. (1892) p. 353.

† Journal of Pathology and Bacteriology, i. (1893) pp. 319–58 (1 pl.).

power of resorption, and the greater number of nuclei is indicative of greater vital activity.

(3) Cutting, including Imbedding and Microtomes.

A Microtome for 50 Cents.*—Dr. Hinz has described his instrument in the 'Omaha Clinic.' The main body is a tin pot 3 in. high by 8 in diameter. A bridge 2 in. wide crosses the top (or open end of the can) and is soldered to the sides of the pot. In its centre is an opening which is the termination of the well, and around the well opening is a glass ring over which the knife is to glide. The space around the well can be filled with ice for freezing. Connected with the well he has a milled screw 4 in. long and with forty threads to the inch. One revolution produces a section 1/40 in. thick; one-half revolution, a section 1/80 in., &c. An amputating knife or razor can be used to cut the sections.

Microtome for Cutting Large Sections.†—Herr O. Schultze describes a new instrument which he has devised for cutting sections of a whole organ or region of the human body. The sections are laid between glass plates and stained so that they can be used for lectures on systematic and topographical anatomy. The instrument is made by Schanze, of Leipzig, and constructed on lines similar to those of other microtomes by this mechanician. The knife-slide is 80 cm. long, and the knife 53 cm. long and 9 cm. broad. The object is fixed to a square iron plate (20 cm. a side) by means of collodion, and the plate clamped to the object-holder, which is moved upwards by means of a micrometer screw. The instrument is capable of making sections of a whole brain 5/100 mm. thick. Before cutting the section, the surface is smeared over with a thin layer of collodion, and each section as it is cut is received on a layer of thin paper.

It requires two persons to work this machine, one to move the knife, the other to manipulate and look after the section.

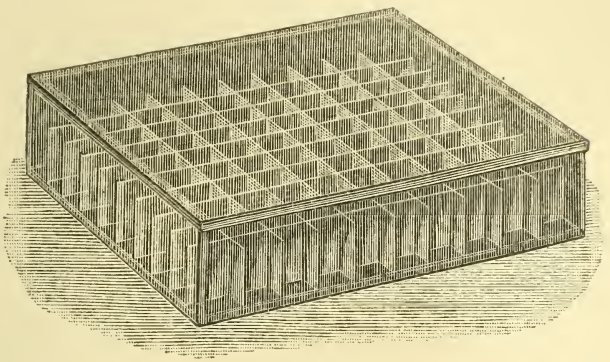
The apparatus is so heavy that it takes two strong men to move it.

Glass Vessel for Serial Sections.‡—Dr. S. A. García describes a convenient form of dish or large capsule subdivided into compartments, which he has devised for the easy manipulation of sections in series. The vessel is rectangular, made of glass and covered with a closely fitting lid, It is obvious that the plan of the apparatus will allow the construction of any number of compartments of any desired size. The subdivisions are made of mica, a substance which, while fitting close enough to the bottom to prevent the sections from escaping from their proper compartment, allows the fluid free passage all over. The author's original apparatus was constructed of nickel, but this does not seem so useful for the purpose as glass. As an example the case of objects imbedded in celloidin is adduced. Here three of these dishes, one filled with alcohol, one with alcohol and ether, and the third with oil of cloves, will greatly facilitate manipulation, as the sections are easily transferred

* The Microscope, xii. (1892) p. 231.
† SB. d. Physik.-Med. Gesell. zu Würzburg, 1892, pp. 116-7.
‡ Zeitschr. f. wiss. Mikr., ix. (1893) pp. 313-5 (1 fig.).

from one vessel to another and deposited in their proper compartment without the trouble of marking.

Fig. 59.



(4) Staining and Injecting.

Staining of Micro-organisms which will not colour by Gram's Method.*—M. Nicolle states that the following method produces very good results for staining micro-organisms which pick up methylen-blue, and especially those of glanders, typhoid, swine fever, pseudo-tuberculosis, fowl cholera, soft chancre:—Stain in Loeffler's or Kühne's blue for one to three minutes; wash in water. Immerse in tannin solution 1–10 (the effect is almost instantaneous); wash in water. Dehydrate in absolute alcohol, oil of cloves or bergamot, xylol, balsam. The micro-organisms are better differentiated if after staining the preparations are treated with weak acetic acid.

Rapid Staining of Nervous Tissue by the Weigert-Pal and Iron Chloride Methods.†— Dr. Kaiser says that nervous tissue, brain or cord, can be stained very expeditiously according to Weigert's method in the following way:—It is most desirable that the pieces should be hardened in a chromic acid solution; four to six weeks in Müller's fluid are quite sufficient, but it is not necessary that the preparations should be placed straight away from the hardening fluid into the alcohol; it is more advantageous to merely wash them out and harden in spirit afterwards, as in this way preparations are more sensitive for other stains.

The sections are taken from 70 per cent. spirit in which they have been kept, and washed in Weigert's hæmatoxylin solution (hæmatoxylin, 1; alcohol, 10; water, 90; saturated solution of lithium carbonate, 1). They are next placed in a fresh quantity of the same fluid in a watch-glass, and then gradually heated until bubbles begin to rise. The sections thus stained are next differentiated by Pal's method:—washing in water, immersion for about half a minute in 0·25 per cent. solution of permanganate of potash, and then in the following solution—oxalic acid, 1; sodium sulphate, 1; water, 200. In the last they remain

* Ann. Inst. Pasteur, 1892, p. 783. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 501.

† Zeitschr. f. wiss. Mikr., ix. (1893) pp. 468–70.

until the grey substance assumes a brown to yellow hue and the white a dark grey. They are then passed through water, alcohol, and oil to balsam.

Scarcely inferior to the foregoing are the pictures obtained by the following procedure:—The sections are placed for some minutes in a mixture of liq. ferri sesquichlorati 1, H_2O 1, spirit. rectif. 3. They are then immersed in the Weigert hæmatoxylin solution, which must be removed as often as a black precipitate falls. When the sections become black they are washed in water and differentiated in the same way as in the previous method. Should they not clear up at once in the oxalic acid solution, the sections should be returned to the permanganate solution until the desired tone is obtained. After this the sections are washed in ammoniated water and stained with fuchsin 0·1, spirit. rectif. 100·0, or naphthylamin brown 1, spirit. rectif. 100, H_2O 200. The fuchsin solution stains in a half to one minute, the naphthylamin brown in three to five minutes. The subsequent treatment is the same as in the first method. The medullated fibres are blue, the rest red or brown. The medullated fibres become dark blue or black if the hæmatoxylin solution be heated. If the differentiation be exactly hit off, the pigment, nuclear network, and nuclei of the ganglion cells become clearly apparent.

Kolossow's Osmic Acid Method.*—Dr. A. Kolossow says that since the last publication of his method he has made further and numerous trials of it, and finds that the following procedure gives the best results. Small pieces of tissue or organs, or even small embryos are, according to size, immersed for 1/2, 1, 3, 5, 8 hours in 1/2 to 1 per cent. solution of osmic acid, to which nitric acid has been added in the following proportion:—5–10 drops of nitric acid to 100 ccm. of the osmic acid solution. They are next washed with some of the developer (a weak solution of pyrogallic acid) and then placed in a fresh volume of the developer for 10–16 hours, after which they are transferred to 85° spirit. The latter must be changed three or four times before the next step in manipulation (imbedding in paraffin) is attempted.

Staining Fungus of Pinus sylvestris.†—Herr F. Schwarz stained the hyphæ of a fungus infesting pine trees in the following manner:—Sections of the affected twigs were removed from alcohol and placed for 3–6 minutes in an old solution of Delafield's hæmatoxylin. They were next washed in water and then decolorized by immersing them for 1/2–2 minutes in 1 per cent. alcoholic oxalic acid solution. When the sections were reddish to the naked eye they were removed, and the oxalic acid thoroughly washed out in alcohol. The sections were mounted either in balsam or glycerin. The fungi were stained violet or deep-blue, while the cell-tissue of the pine appeared yellow or yellowish-red.

Staining Parasitic Fungi.‡—Mr. H. M. Richards recommends for this purpose the use of methylene-blue. A 1 per cent. solution was used, and the sections were stained on the slide. The sections were first

* Zeitschr. f. wiss. Mikr., ix. (1893) p. 320.

† S.A. a. d. Zeitschr. f. Forst- u. Jagdwesen, 1892, 10 pp. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 20–1.

‡ Proc. Amer. Acad. Arts and Sci., 1893, p. 36.

considerably over-stained, and then decolorized to the point desired by acetic acid. After completely washing away the acetic acid, they were mounted in glycerin.

Method for rapid Staining Microbes.*—Dr. J. N. Dávalos recommends as a universal staining fluid for all micro-organisms the following modification of Ziehl's solution:—Fuchsin 0·25, alcohol 10·0, crystallized carbol 5·0, water 100·0. The solution is to be filtered. Coverglasses are floated on for 1–2 minutes, washed and mounted in balsam.

Chromatin of Sympathetic Ganglia.†—Dr. F. Vas followed Nissl's method. The portions of ganglion removed from an animal recently dead were placed in absolute alcohol and imbedded in celloidin. The sections were stained in aqueous solution of magenta-red, washed out in absolute alcohol, cleared in clove oil, and mounted in Canada balsam.

Obregia's Method for Class Purposes.‡—Dr. C. L. Gulland says that he finds Obregia's method, described in the 'Neurologisches Centralblatt' for 1890, is very useful for class purposes. The pieces were imbedded in paraffin and cut with a rocker. The bottom of the boat was intended for the section surface and the pieces were oriented accordingly. The ribbons of sections were transferred to plates coated with the following solution:—Sugar candy solution of consistence of syrup, 30 ccm.; absolute alcohol, 20 ccm.; solution of dextrin of syrupy consistence, 10 ccm. The plates thus coated should be dried in the air, but protected from dust. The plates used were 12 in. by 6 in., in fact as large as would go in the oven. They are then stoved at a temperature a little above melting point of paraffin. In a few minutes the paraffin melts and the sections adhere to the sticky surface. The melted paraffin is then dissolved by running plenty of naphtha over, and this is followed by strong methylated spirit. The sections are then covered with celloidin or photoxylin solution (photoxylin 6 grm., absolute alcohol 100 ccm., ether 100 ccm.), but a thin celloidin solution poured over the surface, and the excess run off, answers well. The plate is dried horizontally, so that the layer is perfectly flat, even, and regular. The drying must be slow, otherwise the celloidin shrinks.

At this point the plates may remain till wanted, as the sugar retains sufficient moisture to prevent the section from getting too dry. When wanted the plates are simply placed in water whereby the sugar is dissolved, and then the ribbons or separate sections can be stained and mounted. The author mentions the Ehrlich hæmatoxylin and aqueous eosin, and these stains were followed by methylated spirit sufficiently strong to dehydrate. When dehydrated the sections are placed in creosote and cleared up. The sections are at this stage handed round the class, and the student then removes the creosote with Weigert's xylol mixture (xylol three parts, phenol one part) and mounts in balsam.

Improved Form of Injection Apparatus.§—Dr. J. Middlemass describes an apparatus for injecting which is easily made and manipu-

* Crónica Médico-quirúrgica de la Habana, 1892, No. 22. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 291.

† Arch. f. Mikr. Anat., xl. (1892) pp. 375–89 (1 pl.).

‡ Journal of Pathology and Bacteriology, i. (1893) pp. 391–9.

§ Tom. cit., pp. 389–90 (4 figs.).

lated, and by which the pressure can be measured and maintained for any length of time. The essential part is a three-necked Woulff's bottle, and the most convenient size is one of 8 oz. By one of the necks compressed air is introduced by a syringe. By another the pressure is transmitted to a bottle containing the fluid to be injected. Into the third fits a graduated manometer tube, the lower end of which dips into a layer of mercury at the bottom of the vessel, and is so arranged that the zero is flush with the mercurial level, and the mercury inside the manometer is brought to the same level by sucking out some air. The pressure is obtained by injecting air by means of some form of syringe, e. g. a Higginson, an aspirator or injection syringe. In the glass tube which leads into the bottle is placed a three-way stopcock, and this is a necessity for regulating the inflow and the outflow of air, and also for reducing or removing the pressure altogether. Two other stopcocks, one on the tube leading from the bottle and the other on the injecting bottle, are also desirable. The manometer may be graduated in atmospheres or in millimetres, &c., of mercury.

(5) Mounting, including Slides, Preservative Fluids, &c.

Chloral for Mounting Microscopical Preparations.*—M. A. Geoffroy recommends the following process especially for preparations of starch-grains, the lower Fungi, Algæ, &c. Three or four grs. of the purest gelatin are dissolved in 100 ccm. of a 10 per cent. solution of chloral hydrate; or the concentration may be varied according as a greater or less clarifying of the preparation is needed. This is applied in the same way as ordinary glycerin, but it is not necessary to remove the fluid entirely from the edge of the cover-glass. After a short time the gelatin hardens round the cover-glass in such a way that the preparation can be fixed in an alcoholic solution of shellac. Preparations made in this way and stained with carmine or iodine-green retain their colour for a very long time, while other stainings are more evanescent.

Keeping Paraffin Sections Flat.†—After pieces of tissue have been hardened, says Mr. N. Walker, they are to be saturated with toluol, chloroform or the like, and then imbedded in paraffin of about 50° melting-point. The difficulty then arises of keeping the sections spread out flat and smooth on the slide. The preparations flatten out quickly if they are dropped into warm water, the temperature of which is just below the melting point of the paraffin. The slide is then put underneath, the section lifted out of the water and dried in an incubator at 30°. The section will be found to have adhered firmly to the slide. The paraffin is then dissolved out in benzol, and the latter having been washed off with alcohol, the preparation is stained in the usual manner.

Influence of the Composition of the Glass of the Slide and Cover-glass on the Preservation of Microscopic Objects.‡—Herr R. Weber remarks that it is a matter of common observation that objects mounted

* Journ. de Bot. (Morot), vii. (1893) pp. 55-6.

† Monatshefte f. Prakt. Dermatologie, xvi. (1893) p. 113. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) p. 344.

‡ Ber. Deutsch. Chem. Ges., xxv. (1892) pp. 2374-7.

in the usual way between slide and cover-glass often, after a short time, begin to deteriorate so that the sharpness of outline is lost, and the object is sometimes completely ruined.

The result of the author's observations is to show that this deterioration is due to the effect upon the object of the material of the slide and cover-glass.

The ordinary glasses used in microscopic work vary in their behaviour after long exposure to the air: while some retain their bright surface lustre others of inferior quality gradually lose it and become coated with a moist or dusty deposit. The same phenomena are exhibited by ordinary glass articles (mirrors or window panes) of different qualities.

This deposit has a strong alkaline reaction, and, when formed on cover-glass or slide, has a considerable injurious action upon delicate objects mounted between them.

Now as regards the slides, in their production a soft glass which is almost perfectly colourless is often used. The components of this glass are pure alkalies and calcium carbonate with sand free from iron. The amount of calcium is limited as much as possible on account of the fusibility. Such a glass is known in German commerce as "Salinglas." It is peculiarly liable to the deposit above described, which is sometimes strongly developed even in process of transport.

Analysis of such slides by the author gave the following numbers:—

SiO_2	73·06
Al_2O_3	0·90
CaO	8·47
K_2O	3·87
Na_2O	13·70
	100·00

This gives the molecular ratio

SiO_2	:	CaO	:	$\begin{cases} K_2O \\ Na_2O \end{cases}$
8·2		1		1·74.

According to the author's previous experiments, such a glass is less hard, and therefore less to be recommended than glasses in which the molecular ratios are

$$6 - 7 : 1 : 1 - 1{\cdot}3.$$

Besides these colourless slides, others which have a slightly green tint are used, and these are much less liable to show a deposit. They are made of a window glass, rich in calcium and poor in alkalies, which is much more difficultly fusible.

Cover-glasses exhibit the same differences as slides, some remaining unchanged by exposure while others lose their lustre. Those of English manufacture are the best, are less liable to form a deposit, and are also distinguished by uniformity in the strength, evenness and purity of the material. They are generally of a slightly greenish-blue tint. The cause of the different behaviour of the English and other cover-glasses

depends on the different composition, as shown in the following analyses:—

	English Cover-glass.	Other Cover-glass.
SiO_2 ..	71·00 ..	74·77
Al_2O_3 ..	0·57 ..	0·45
CaO ..	13·76 ..	10·75
MgO ..	0·31 ..	0·33
K_2O ..	0·20 ..	0·20
Na_2O ..	14·16 ..	13·50
	100·00	100·00

In the first case the proportion of lime to alkalies is greater than in the second, and to this is due one of the most important properties of the English glass, viz. its resistance to the effect of moisture and other agents.

For delicate, easily perishable microscopic preparations, then, a highly resisting glass with very high content of lime is absolutely essential, although the production of cover-glasses is thereby rendered very difficult.

The usefulness of a glass for delicate preparations may be tested by observation of its behaviour on keeping for a long time in air free from dust, or more expeditiously by the effect upon it of dilute hydrochloric acid during 24 hours.

Method of Mounting Calcified Microscopic Specimens.*—Mr. J. Mansbridge gives the following description of the method of mounting which he has adopted for certain dry calcified sections where it is advisable to retain air in the structure for purposes of clear definition.

"One great disadvantage in the use of a fluid balsam as a mounting medium for this class of sections, is the liability to run into any spaces, such as lacunæ or tubuli that may exist in the tissue, and thus render the specimen useless. To overcome this difficulty I have used with success desiccated balsam in the following way:—Take a clean slide, place it upon a hot table with a small single lump of balsam upon it; use sufficient heat to slowly melt the balsam, which must not be made too hot. When sufficiently fluid lay the section upon it and cover with a hot cover-glass, which must be pressed down in such a way as to expel all air from beneath it. Remove the slide to a cool surface and continue to keep pressure upon the cover-glass for a few minutes, when the balsam will be found to be quite hard and the specimen ready to be labelled and put away finished.

The advantages of this method are, I think, (1) There is no chance of the mounting medium running in and spoiling the sections, as it becomes perfectly hard a few minutes after removal from the hot table. (2) The specimen is finished at the time and is ready for the cabinet. There is no need to use a clip, and no fear of the cover-glass shifting if the slide is placed upon its side. (3) It is very convenient for teaching purposes, as the ordinary stiff balsam in a bottle furnished with a glass

* Trans. Odont. Soc. Great Britain, xxv. (1893) p. 176.

rod, if used in a class, soon becomes, together with the students, in a most deplorable condition.

(6) Miscellaneous.

The Microscope in the Workshop.*—Prof. W. A. Rogers calls attention to the advantages to be derived from the use of the Microscope in the ordinary operations of machine construction.

The two objections generally urged against its adoption are, that a special and expensive machine, mounted on a foundation separate from the building, would be required for its use, and that without special appliances an adequate illumination of metal surfaces could not be obtained.

The author considers that both these objections may be met.

With regard to the first it is only necessary to have the Microscope firmly clamped to any machine with which it is to be used. The form of mounting used by him has been found to be well adapted to the purpose. It is found that with powers of from 100 to 200 the images in the Microscope are remarkably steady.

The second objection is met by the use of the prism illuminator invented by the late R. B. Tolles. This prism is mounted just at the back of the objective. The light meeting a plane face passes to a facing, making with it an angle of 45°, where it is totally reflected and passes out nearly parallel with the axis of the lens.

The author gives twenty-four examples of operations in which the Microscope may be advantageously employed.

Blood and Blood-stains in Medical Jurisprudence.†—Mr. Clarke Bell gives a summary of the present state of scientific knowledge on the subject of the identification of blood and blood-stains. The red blood-corpuscles afford the best means for discriminating between the blood of man and other animals.

Three methods of investigating blood have been employed, viz. (1) chemistry; (2) the spectroscope; (3) the Microscope and its allies the micrometer and the photomicrogram.

No chemical differences have been discovered between the blood of man and of other animals.

The Microscope, however, has shown that the human corpuscle is larger than those of most of the domestic animals.

The average diameter of the human red blood-corpuscle is 1/3200 in.; that of the sheep 1/5000; the goat 1/6366; so that these can be easily distinguished under the Microscope; as also those of the horse 1/4600, cow 1/4500, cat 1/4004, pig 1/4230, and mouse 1/3814.

There is greater difficulty with animals such as the dog, whose red blood-corpuscles more nearly approximate in size to those of man.

Prof. Formad has, however, recently claimed that by the use of very high magnifications, up to 10,000 times, obtained by rephotographing single corpuscles of different animals, he has obtained the following measurements. The human corpuscle was enlarged to $3\frac{1}{8}$ in. in diameter, guinea-pig to 3 in., dog to $2\frac{4}{5}$ in., ox to $2\frac{1}{8}$ in., sheep 2 in., and goat $1\frac{3}{8}$ in.

* Proc. Amer. Micr. Soc., xiv. (1893) pp. 128-31. † Tom. cit., pp. 91-120.

With these high powers he claims that it would be possible to state that corpuscles were *not* those of the sheep, goat, horse, cow, or ox, and probably the dog, or of any Mammal except the guinea-pig or opossum.

Prof. Wormley, on the other hand, who has made determinations of the apparent size of red corpuscles under a magnification of 1150, came to the general conclusion "that the Microscope may enable us to determine with great certainty that a blood is *not* that of a certain animal, and is *consistent* with the blood of man; but in no instance does it in itself enable us to say that the blood is really human, or indicate from what particular species of animal it was derived."

Prof. Formad's methods of observation of blood-corpuscles are as follows:—

A drop of blood is placed upon a slide and the edge of another slide is quickly drawn across so as to distribute the corpuscles as evenly as possible between them.

Two micrometers, the one a stage-piece, the other an eye-piece micrometer, are used. The stage micrometer, which consists of a glass slide ruled to a scale either in millimetres or fractions of an inch, serves to establish the correct value of the lines ruled upon the micrometer.

The eye-piece micrometer is a slip of glass, with fine lines ruled to a uniform scale, which fits into the eye-piece of the Microscope. By the stage micrometer the number of divisions of the eye-piece micrometer required to fill one of the divisions of the stage micrometer is noted. Thus, if with a 1/12 Zeiss homogeneous-immersion lens the 1/100 in. division of the stage scale covers exactly twenty places in the eye-piece scale, then each division of the eye-piece micrometer will be equal to the 1/20000 in. When the adjustment of the scale has been thus made the slide is brought into focus under the eye-piece micrometer and the number of divisions occupied by a blood-corpuscle is noted. The average of 100 measurements made in this way upon perfectly round biconcave corpuscles only is then taken.

For photographic purposes the blood is mounted directly upon a glass stage micrometer, and both blood and micrometer appear sharply defined in the picture. The measurements are then made directly upon the negative.

Böhm and Oppel's Pocket-book of Microscopical Technique.*—This little manual has now got into its second edition, and it deserves some praise, as it is an excellent compendium of the myriad details necessary for the examination of animal tissues. The first section deals with the Microscope, its accessories and manipulation, and the second section with the preparation of the object. After this follows the special part in which the organs and tissues are separately treated of.

It is certainly one of the most useful compilations we have seen, and it would no doubt command, if in an English dress, a considerable sale, for a little pocket-book on microscopical technique is a desideratum. The get-up of the work is very good.

Mixtures of Antiseptics.†—M. J. de Christmas after alluding to the fact that several observers had laid it down that mixtures of several

* 'Taschenbuch der Mikroskopischen Technik,' A. Böhm u. A. Oppel, 2nd ed., Munich, 1893, 192 pp.

† Ann. Inst. Pasteur, 1892, p. 374. See Centralbl. f. Bakteriol. u. Parasitenk., xiii. (1893) pp. 107–8.

antiseptics possessed greater antibacterial power than any one of the components taken singly, points out that the method of examination had not been free from objection, and the results were without any special practical value, inasmuch as the antiseptics had been used of such strength as would preclude their application to the living organism. Yersin was the first to adopt a satisfactory method, and the author has followed his procedure.

Phenol and salicylic acid formed the basis of the mixture, the presence of the former increasing the solubility of the latter. By the addition of organic acids a still further increase of the bactericidal properties of the mixture was attained, as was shown by its action on *St. pyogenes aureus*.

In one table is shown the superiority of this kind of mixtures over all known antiseptics, with the exception of sublimate, and in a second table are given the different degrees of concentration of "phenosalyl" necessary for destroying different species of bacteria, *St. pyogenes aureus* being the most refractory.

Determination of Pectic Substances in Plants.*—M. L. Mangin recommends for this purpose the action on thin slices of tissue of a mixture of naphthylene-blue and acid green, which gives a double staining reaction, the acid green being fixed by the nitrogenous substances lignin and suberin, while the pectic substances are stained violet by the naphthylene-blue. The preparation should first be neutralized, after washing with 1·5 per cent. acetic acid. The presence of pectic acid can be demonstrated by separating it from its base by the action on very small pieces of tissue of dilute hydrochloric acid or a mixture of 1/4 acid and 3/4 alcohol. Pectic acid is quite insoluble in water; it can be dissolved out by the action of a weak alkali, and then precipitated in gelatinous flakes by a weak acid. The ill-defined substance known as pectose, which remains behind after the action of the alkali, is not readily isolated.

* Journ. de Bot. (Morot), vi. (1892) pp. 363–8.

PROCEEDINGS OF THE SOCIETY.

Meeting of 19th April, 1893, at 20 Hanover Square, W., The President (Albert D. Michael, Esq., F.L.S.) in the Chair.

The Minutes of the Meeting of 15th March 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 were given to the donors.

	From
A. Woodward and B. W. Thomas, The Microscopical Fauna of the Cretaceous in Minnesota. (4to, 1893)	*Mr. F. Crisp.*
5 Slides of Cattle Ticks	*Mr. R. T. Lewis.*
Report and Proceedings of the Ealing Natural History and Microscopical Society, 1892	*The Society.*
7th Annual Report of the Bureau of Ethnology .. .. Contributions to American Ethnology. Vol. vii.	*The United States Government.*

Mr. E. M. Nelson said that Dr. H. G. Piffard in the 'New York Medical Journal' for July 16th, 1892, proposed to project, for purposes of drawing, &c., the real image from the Microscope on to the paper, instead of employing a camera or similar instrument. This method, which is very successful in the case of low powers, is not new; it was exhibited by himself, both at the Society and at the Quekett some time ago; but the point he wished to bring out was the position of the prism in Dr. Piffard's arrangement. Dr. Piffard had placed it between the eye-piece and the objective, whereas it ought to be in the eye-cap. In fact a piece of plain looking-glass mounted in the eye-cap at an angle of 45° answers the purpose perfectly, working well up to a magnifying power of 300 diameters, and at the same time is quite inexpensive. As no notice was taken of his previous communication, Mr. Nelson said that he thought it better to bring it again before the Society, as such a simple and useful device should be better known.

Mr. C. Rousselet showed a new compressorium (see *ante*, p. 386) for the exhibition and examination of minute free-swimming animals, the great advantage of which was that it enabled an object to be seen in every part of the field.

Mr. R. Macer exhibited and described a new reversible compressorium which he thought would meet a want often felt by those who, after examining a specimen placed on the stage in the ordinary way, wanted to see the other side. Finding Beck's form to be very inconvenient in use he had tried to design one which would answer the purpose better, and had brought it to the meeting for inspection. It would be

seen that it worked parallel. It was made long in order to get it over the stage. He had not secured the design in any way, but left it entirely open to any one to adopt it if they wished to do so.

Dr. W. H. Dallinger thought this form of compressorium certainly had the advantage of being able to be turned over completely and easily. Beck's form had also the advantage of being parallel, but on account of its sliding movement it was very apt to injure minute organisms placed within it. The one now exhibited had a parallel motion, but it was only so when it could be used in a parallel way; he was afraid, however, that it might be found a little hurtful for high-power work. It was, apart from this, an exceedingly simple and useful device.

Dr. G. P. Bate inquired what advantage this was considered to possess over Rowland's reversible compressor, described in the last edition of Carpenter's 'Microscope,' pp. 295 and 6, which could be turned over without removing it from the Microscope?

Mr. Macer said that Rowland's was placed so far from the condenser that it could not be used for work which required a high-power condenser.

The President thought the fact of Mr. Macer's form being able to be used with a condenser was a very substantial advantage; it certainly seemed to be a very useful piece of apparatus. Mr. Rousselet's pattern was also a very practically useful instrument, and the thanks of the Society were due to both these gentlemen for bringing their devices under their notice.

Surgeon Lieut.-Colonel Bate showed a very little known method of illuminating diatoms, which he called "white ground." The method is simple and only requires ordinary apparatus. The Microscope is arranged as for dark-ground illumination with the largest stop in the Abbe condenser on the substage, a 12 mm. apochromatic with compensating eye-piece 27 on the tube, and a *Triceratium* or other suitable diatom on the stage.

Adjust as for best dark ground, and on moving out the arm carrying the stop (which should work rather stiffly), a point will be found where the dark ground just disappears and is replaced by creamy white; the diatom is now seen strongly illuminated and glowing like fresh minted silver on a dull ivory ground, and as the shadows are rather strong the effect is exactly that of opaque illumination with a Lieberkühn. There is no distortion, details are shown with remarkable clearness, and in stereoscopic relief. The use of monochromatic light by means of a bottle of copper solution improves the effect.

The President said they were all aware how clearly and strongly an object appeared to stand out under this class of illumination, the only question being whether the method did not produce some amount of distortion, and whether therefore the beauty of the effect was not obtained at the cost of some accuracy.

Prof. F. Jeffrey Bell read a letter received from Captain Montgomery, of Ismont, Natal, describing the abundance of ticks in that colony.

The President said there could be no doubt that the tick question

was becoming one of very serious import in some of our colonies, so much so indeed that it behoved Government to give it careful attention.

Mr. H. M. Bernard gave a *résumé* of his paper 'On the Digestive Processes in Arachnids,' illustrating his remarks, as he proceeded, by diagrams drawn upon the blackboard.

Prof. Bell said they were greatly indebted to Mr. Bernard for his very interesting communication which appeared to open up a new field of observation. Of course, as Mr. Bernard had seen the preparations to which he had referred, he was in a better position to form an opinion than those who had only heard them described, but without seeing them one was inclined to ask whether after all there was not likely to be some mistake. If this were not so, it would appear that digestion was not confined to the digestive tract as usually understood, and in that case it might be that they were at the beginning of a series of observations which would throw a new light upon the subject of the digestive processes. He hoped that Mr. Bernard would be able to continue his observations until he arrived at facts which might be of great physiological importance.

The President said he had never worked much on these groups, except amongst the Acarina. With regard to the so-called "fat-body," he took it to be the brown coating of cells which many of the German writers had termed the "liver stomach." Of course the question was what was the function of this coating of brown cells? The old idea that they were liver cells had been disputed and materially shaken, and Professor Ray Lankester was of opinion that they had a blood-elaborating office. With regard to the crystals, there was no doubt that they did exist in large quantities, and that they accumulated so much as actually to show through the skin in a definite pattern; in fact at one time, before this was recognized, numerous species were named from them by those who regarded them as distinctive markings. It was a curious thing that the distribution of these crystals was by no means the same in different families of Acarina; in the majority of cases they lay outside the canal altogether, and were not found inside at all until they reached the hind-gut. In the Gamasidæ they were poured into what Mr. Bernard called the stercoral pocket, or cloaca, entirely from the Malpighian vessels, which were two only in number. That was the name they always went by, and though it was quite possible that they were the analogues of the Malphigian vessels, it by no means followed that they were the homologues, because they entered into the narrow portion of the hind-gut or cloaca just before it entered the stercoral pocket. In the rectum there was a short narrow portion and just at that part the two Malphighian vessels poured out their contents into it, and it was from them alone that, in the Gamasidæ, these crystals proceeded. On the other hand there were other families, such as the Tyroglyphidæ, where these crystals apparently never entered the hind-gut at all, but were spread through the general body-cavity, there being no definite channel by which they escaped; they did not appear to accumulate, but were spread about the body-cavity in small masses and they were more or less stored up in the body, and were probably never got rid of at all.

In the Oribatidæ a medium course seemed to hold good, it being very difficult to ascertain where they entered the hind-gut, and were found in the rectum, whilst in the Trombidiidæ they seemed to enter in a definite channel down the centre of the back. His very decided opinion was that it was not a continually changing road but was a fixed and definite process which remained through all stages. It was clear that they were by no means at the end of the investigation, and it seemed also necessary to take into account the fact that fresh specimens did not give the same results as those which had been acted upon by reagents, because it seemed certain that the reagents acted upon them in a way which caused them to be thrown down as crystals earlier than they would have been in the natural course. The whole subject was obviously one of great interest. The breaking loose of very large cells in the interior of the ventriculus was a very common thing amongst the Acarina, and also a very conspicuous thing. His own observation showed that they did pass out from the anus, where the food was abundant, but at present he did not see any sufficient evidence that they passed through the tissues and became blood-corpuscles. Mr. Bernard had opened up a very interesting and important subject which it was to be hoped he would be able to follow out.

Mr. F. Chapman read a paper 'On the Foraminifera of the Gault of Folkestone,' in continuation of the series of papers on the subject already read before the Society.

Prof. Bell said he had been asked why some extra copies of Mr. Chapman's previous papers had not been printed, so as to publish the whole series together as a separate work. The reason was that the editors of Societies' publications were not unaccustomed to receive promises of series of papers, and they were usually presented with Part I., sometimes they received Part II., but scarcely ever Part III., and Part IV. was almost unprecedented. He wished they had known that with regard to the present series they had to deal with so patient a worker as Mr. Chapman had proved himself to be; he was certainly to be congratulated upon what he had already accomplished.

The President was sure that every one would appreciate the amount of patient labour which Mr. Chapman had devoted to this subject, one which possessed special difficulties, because there was no group of organisms where species more ran one into the other than was the case amongst the Foraminifera.

Prof. D'Arcy Thompson's paper 'On a Tænia from an Echidna' was read by Prof. Bell (*ante*, p. 297).

Mr. C. Haughton Gill called attention to two specimens of pure cultivations of diatoms which he was exhibiting under Microscopes in the room, which he thought might be of interest.

The thanks of the Society were voted to the authors of papers and other communications which had been brought before the meeting.

The following Instruments, Objects, &c., were exhibited:—

Dr. G. P. Bate:—Diatoms illuminated by reflected light from the cover-glass.

Mr. F. Chapman:—Foraminifera of the Gault of Folkestone.

Mr. C. Lees Curties:—*Filaria sanguinis hominis*, Zeiss. Apo. 1/6 N.A. ·95, Achromatic Condenser and Compensating Ocular.

Mr. C. H. Gill:—Pure Cultivations of Diatoms—*Amphora* sp., *Cymatopleura solea* var. *hibernica*.

Mr. R. T. Lewis:—Young Ticks found upon the heads of grass stems.

Mr. R. Macer:—New Reversible Compressorium.

Capt. Montgomery:—Bee Parasites.

Mr. E. M. Nelson:—A Reflecting Mirror.

Mr. C. Rousselet:—*Notops brachionus*, living and preserved. A new Compressorium.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. Francis N. G. Gill, Louis Bert de Lamarre, Prof. Albert E. Mettam, and Mr. William Henry Wilkinson.

Meeting of 17th May, 1893, at 20 Hanover Square, W., The President (A. D. Michael, Esq., F.L.S.) in the Chair.

The Minutes of the meeting of 19th April 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 were given to the donors.

	From
Report of the Zoological Collections made in the Indo-Pacific Ocean during the voyage of H.M.S. 'Alert.' (8vo, London, 1884)	*The Trustees of the British Museum.*
Prof. F. J. Bell, Catalogue of the British Echinoderms in the British Museum (Natural History). (8vo, London, 1892)	

Prof. F. Jeffrey Bell called attention to two books which had been received from the Trustees of the British Museum. The first of these was an account of the zoological collections made during the voyage of H.M.S. 'Alert,' and the other was the catalogue of British Echinoderms already mentioned in the Society's Journal; this contained, amongst others, six plates, illustrating the spicules of all the species of Holothurians found in the British seas.

The President said that though these volumes might be regarded as a species of exchange, the rules of the Museum required that they should be sent as a present from the Trustees to the Society, so that it would no doubt be the pleasure of the meeting to return a special vote of thanks for this valuable donation.

Prof. Bell said that the Council had, owing to the uncertainty as to the unfortunate fate of Prof. Hermann Fol, taken no steps up to that time

for the removal of his name from the list of Honorary Fellows of the Society. All they knew was that Prof. Fol had started upon an expedition about eighteen months ago in a French ship of which nothing whatever had since been heard. The Council had, however, now thought it desirable to declare the vacancy, and had also proposed to fill it by nominating Dr. Robert Hertwig.

Mr. G. C. Karop read the following letter from Dr. R. L. Maddox, with reference to a recent communication from Dr. A. M. Edwards on the subject of his illuminator.

"In the Society's last journal (April), I find at p. 286 there is a note from Dr. A. M. Edwards, of Newark, N.J., U.S., on "A Simple Illuminator," and a statement made that for the "Rod Illuminator" described by me and figured in the Journal, 1890, p. 101, I used a prism of glass ground down and placed beneath the object." Reference to the Journal will at once show this to be an error. The illuminator was made from glass rod both white and blue, which I ground down on its long side to nearly the half-diameter, then polished and mounted it for use.

I am glad to have Dr. Edwards' testimony to its utility, and believe if made of different coloured glass, it might be useful, not only as an illuminator, but also as a light-filter when photographing small stained objects.

Pray excuse me troubling you with this little correction."

Mr. Karop also read the following letter from Mr. W. H. Youdale, referring to some diseased beard-hairs he had sent to the Society:—

"I herewith send you some of my attempts to stain the diseased beard-hairs. They are very difficult to manage as they always break off at the diseased part when put in the staining fluid. I, however, also send some unprepared hairs for experimental use by any of your Fellows who will be kind enough to give you an idea of what the disease is, when you will perhaps communicate to me what you find out about it. In case you may have destroyed or mislaid my former letter, it will be advisable to briefly memorize the chief points of the disease. It seems to affect *only* the beard-hairs, and to render them *brittle* at the diseased part, which becomes swollen, causing the cells of the hair apparently to separate like those of a cane bruised by bending. The hair breaks at the diseased part by simply bending it. The diseased part too is lighter in colour, giving the impression that the beard has "nits" upon it. All the hairs are not diseased but about one-third to two-thirds of the entire number. There are many diseased parts on the same hair. The effect on the hair can be well observed on the accompanying unprepared hairs by viewing them when placed on a piece of dark-blue paper. I am sorry the stained specimens sent are such duffers, but they are really most intractable."

Mr. Karop said he had not been able to examine these specimens but he would do so, and from the description given he expected that they would turn out to be examples of what was known as *Sycosis menti*.

Mr. C. Lees Curties exhibited a new form of camera lucida which he had just received from Herr Leitz of Wetzlar, which could be used with the Microscope in any position. It was a single prism, non-revolving, and gave a view of the whole field of the eye-piece, but as it had only reached him that afternoon he had been unable to experiment with it. The one exhibited was made to fit the usual continental model; it formed its own eye-piece and was about equal in power to the ordinary B.

The President thanked Mr. Curties for bringing this little piece of apparatus for exhibition.

Sir David L. Salomons having been called upon by the President to give an exhibition with his Projection Microscope, prefaced his remarks by expressing a hope that he was not displacing a paper which he had noticed was also announced to be read that evening. In bringing his lantern before them he was going to show them a few examples which were not altogether connected with the Microscope, but which he thought they might be interested in seeing, as showing how wide a field it was able to cover for purposes of scientific illustration. He thought, however, that it was due to the Fellows of the Society present to say that he had been unable to test the apparatus in that room before the meeting on account of not being able to obtain darkness, so that it might be necessary to make some few adjustments as he proceeded. He had also not been able to make use of any very high powers, because they would necessitate the use of a more powerful light than it would be possible for him to obtain on that occasion. He employed as an illuminant an electric arc light, and the use of a high power necessitated a larger current than it might be advisable to use, not being quite sure of the capacity of the wires in the building to carry it, and not caring to run the risk of some of the fuses going and so spoiling the exhibition. The lantern-case was made so as to turn freely upon a centered ring platform enabling either of the nozzles to be turned towards the screen as might be required. The cylindrical case was fitted with a catch for getting the optical apparatus properly centered, and this was so constructed that he was able to tell by touch when the adjustment was correct. The first picture thrown upon the screen was a photograph of the apparatus, showing it with the polariscope on the right and the Microscope on the left. No. 2 showed it from another aspect with the Microscope nearly facing the observer, also showing the third front; and No. 3 gave a view of the table used in connection with it for use in the exhibition of chemical or electrical experiments. The projection Microscope was then brought into position and the following objects were exhibited:—The proboscis of blow-fly; section of eyelid; transverse and vertical sections of scalp showing hair-follicles; section of lung of frog; section of toe of mouse; ovaries of house-fly; section of eye of fly; acarus of carrion crow; larva of bot-fly; section of mineral; hair of Egyptian mummy; piece of a feather of emu; sections of wood of camphor tree in three directions; pollen-grains *in situ*; stinging organs of nettle; starch-granules in section of potato; mineral section; filariæ in blood—in febrile disease; *Trichina spiralis* in pork; palate of garden snail; spicules of *Gorgonia* and *Holothuria*; hair of Indian

bat; stings of bee; sections of cinnabar and fossil coal; stings of queen wasp; micrometer scale.

The instrument was then rotated so as to bring the polariscope into operation; the value of this portion of the apparatus, i. e. polariscopes in general, was that it enabled an optical examination to be made of phenomena which could otherwise only be demonstrated by mathematics. The subject of the polarization of light being one which had not yet been exhausted, it was consequently very difficult to explain the subject in simple language. As a rule it might be taken that a ray of light vibrated in all directions, but when it was polarized it was made to vibrate only in one, which constituted plane polarization, or it might be circularly polarized, or elliptically polarized. It could of course be easily imagined that if the polarization was in a vertical direction, and a crystal which would not allow vertical vibrations to pass through was placed in the path of such a ray, the light would be stopped. The object of the first of his series of illustrations would be to show that the effects produced by certain crystals, and other substances which could polarize light, was due to their being more or less in a state of strain. Strains take place in a substance in three directions at right angles to one another; if they were all equal they might be said to balance each other and no polarization effects were then produced; if two were equal there would be polarization of one kind, and if all were unequal they would produce phenomena of another kind. The following were then exhibited upon the screen:—A piece of calc-spar, to show the effects of interference; a piece of glass placed under strain by pressure from a screw; a Prince Rupert's drop; a piece of chilled glass; pieces of glass in a state of strain (chilled); thin pieces of mica crossed; figures of a butterfly and of "Baker turned sweep" cut in selenite; polarized ray passed through various films; selenite picture of plum with leaves; crystals of benzoic acid; section of labradorite; bi-quartz, the prism being set so as to obtain a uniform tint on both halves, the equivalent of a solution containing 10 per cent. of sugar 20 cm. long was placed in the path of the ray, causing a difference in tint to be at once observed; piece of quartz cut convex.

The rays were then condensed so as to become convergent instead of parallel in order to show better the internal structure and condition of a crystal, and the following were shown:—Apopholite, a uni-axial crystal which exhibited the black and white cross and no colour; piece of calcite, the emerald; sugar, cut perpendicular to one axis, a bi-axial crystal exhibiting one arm of the cross; tartarate of potash; crystal showing the crosses; sections of quartz crossed; colour rings in crystals showing two axes; a crystal of selenite, naturally bi-axial, but when heated it became first uni-axial and then bi-axial at right angles; "star" sapphire, showing the six stellate rays produced when the crystal was placed in the path of a small parallel beam, a phenomenon from which the name was derived.

A large convex lens was then fitted upon the projecting arms of the lantern, and a powerful parallel beam of light being thrown on the screen various diffraction effects were produced by means of a grating ruled 2000 lines to the inch, which exhibited the secondary spectra in a remarkably clear way. Similar phenomena were also shown by means of two such gratings crossed, and also by a circular grating. These

were shown to explain the use of large aperture objectives for viewing minute structure.

Mr. E. M. Nelson said he had been much delighted by the very beautiful exhibition which they had just witnessed. Some of the experiments had been of very great rarity on account of the extreme scarcity of good specimens of some of the crystals employed.

The President said the Society was extremely indebted to Sir David Salomons for the very admirable and interesting exhibition which he had given them, the value of which was not only on account of the refraction phenomena which had been so well shown, but because of the advance which was indicated in the construction of the apparatus. The lantern was increasingly becoming a means of illustration, and in connection with it the projection Microscope was coming to the front. Lantern illustration was undoubtedly the most attractive method for class purposes and for large audiences, but where the ordinary lantern was used it involved the trouble of the preparation of lantern-slides, so that every step in the direction of the improvement of the projection Microscope was to be welcomed as most important, since it enabled the actual objects to be shown. Their thanks were, therefore, due to any one who helped to improve the instrument. He could not help observing, as the exhibition proceeded, that there was a remarkable flatness of field not generally seen under similar circumstances; the difficulty, of course, was always to get sufficient light for the purpose, and when this was obtained it was usually at the sacrifice of some degree of flatness. There was one point on which he should like to ask for information: it sometimes arose that the great concentration of light produced also a great concentration of heat, and that consequently objects in balsam if exposed for too long a time were apt to get spoilt through the softening of the medium. Was this difficulty got over in the present instance by using the electric arc light as an illuminant?

Sir David Salomons said this question was one very much to the point, because the difficulty mentioned was one of the first met with. He obviated it very much by using lenses cemented with balsam. The customary alum and water he found to be rather troublesome and so he used distilled water and found that it answered every purpose. He should have been glad had it been possible to have used a larger current for the arc lamp to increase the brilliancy of the disc, but for the reason already mentioned he had been unable to do so.

A hearty vote of thanks was then passed to Sir David Salomons on the motion of the President.

The following Instruments, Objects, &c., were exhibited:—

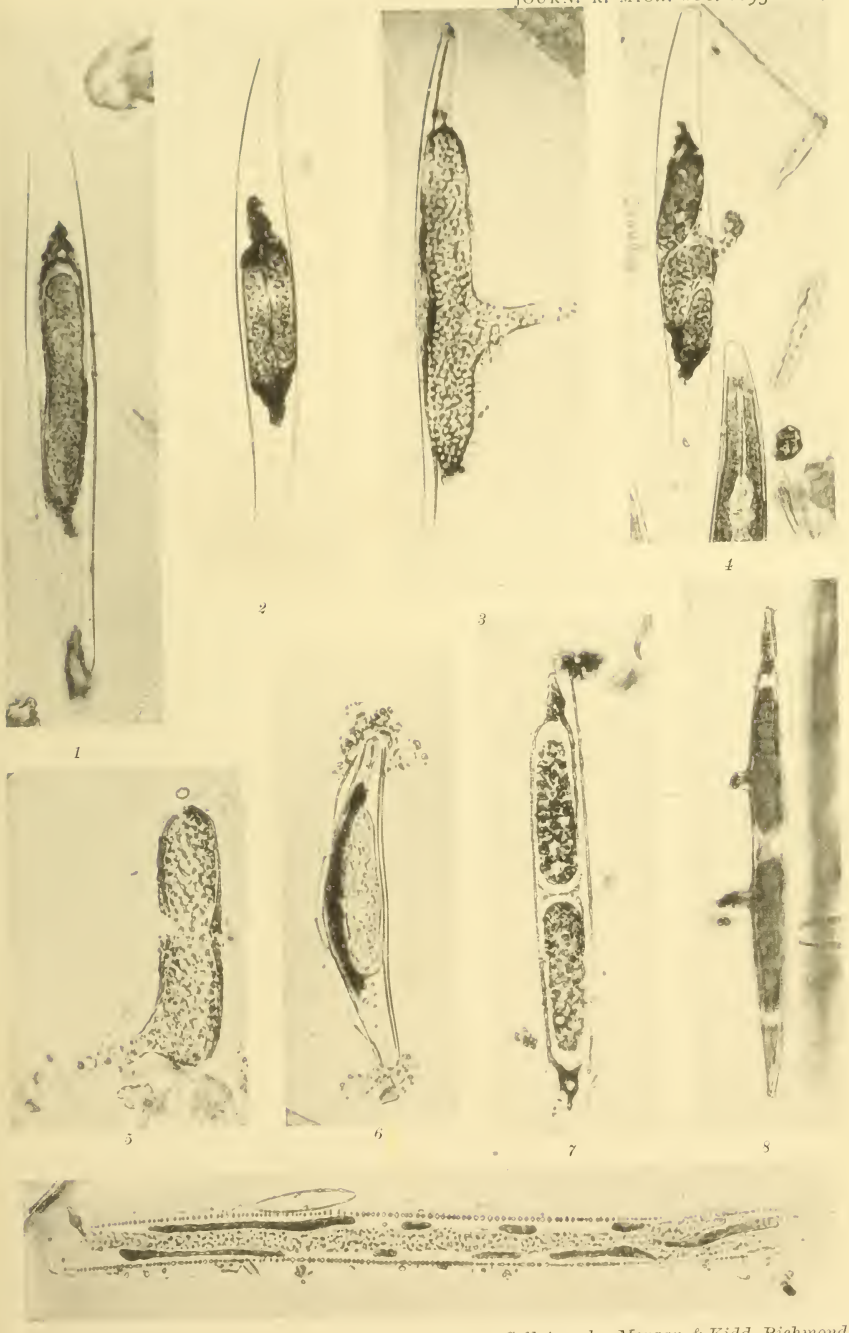
Mr. C. Lees Curties:—New form of Camera Lucida by Herr Leitz of Wetzlar.

Mr. C. Rousselet:—Rotifers.

Sir David L. Salomons:—Exhibition with the Projection Microscope.

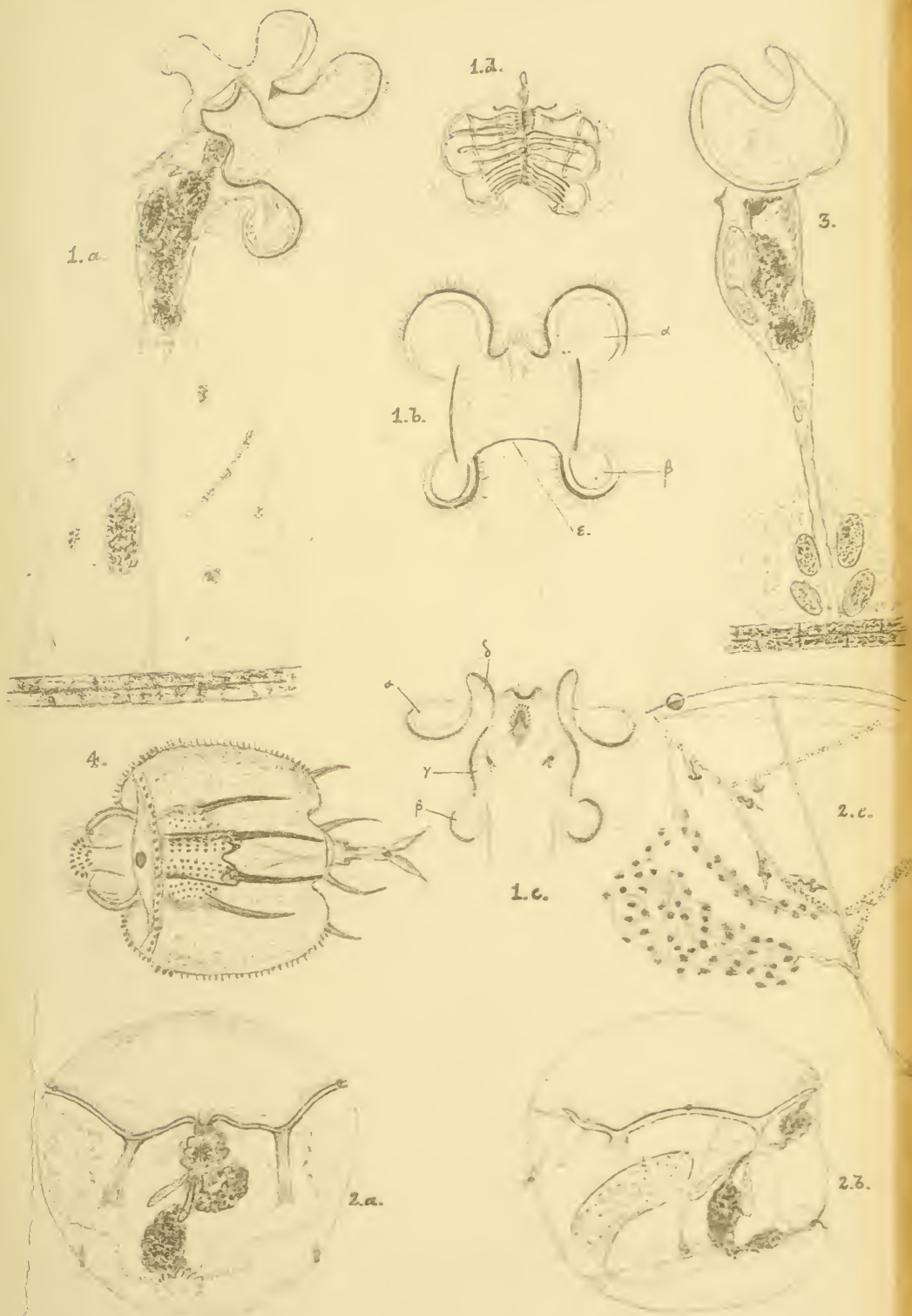
Mr. W. H. Youdale:—Diseased Beard-hairs.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. James Adams and Joseph Gritton, Prof. James W. Hartigan, Dr. Walter Cairns Johnson, Messrs. George Mellors, and Frank S. Morton.



C. H. Gill, Phot. 9. *Collotype by Morgan & Kidd, Richmond.*

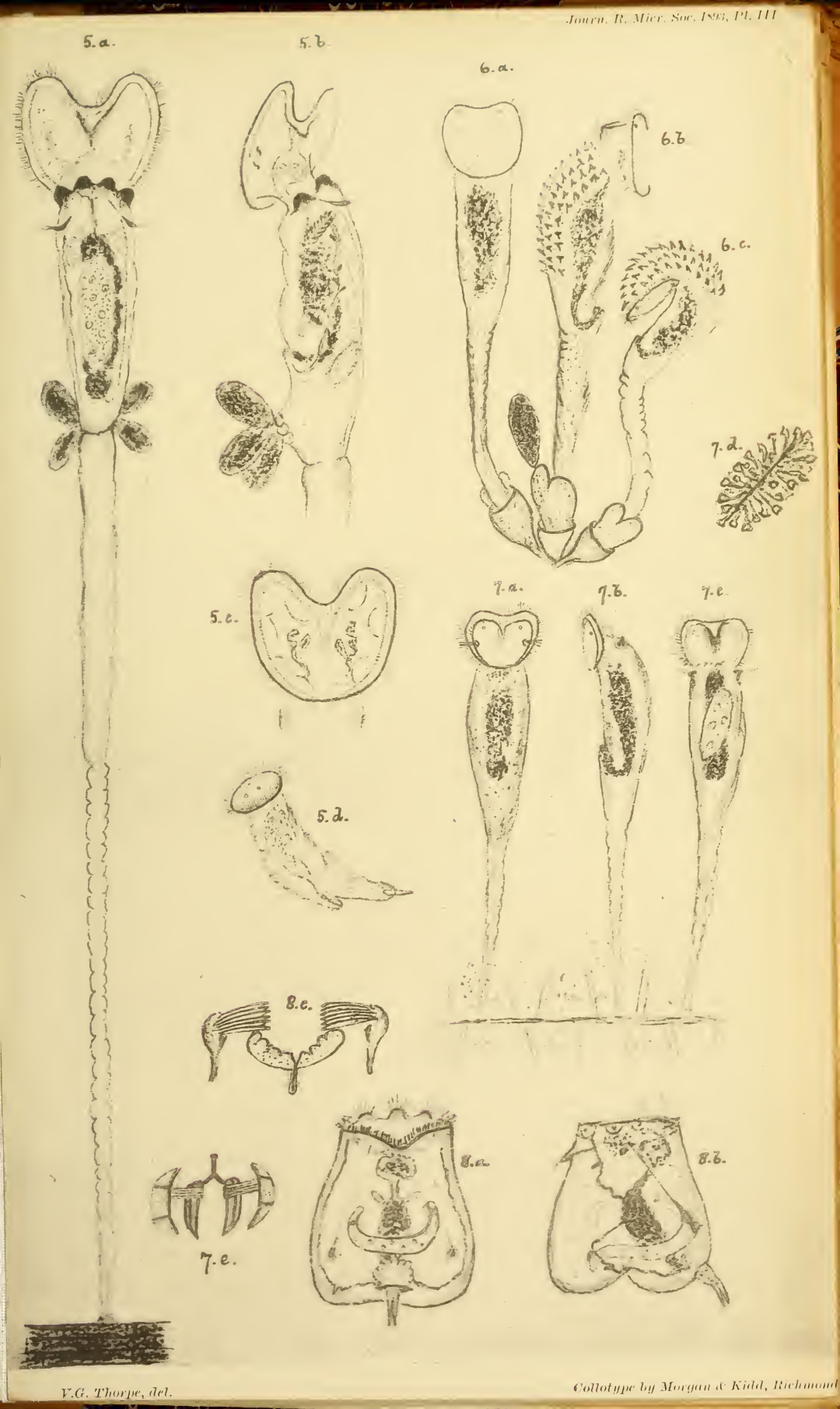
ENDOPHYTIC PARASITES IN DIATOMS.



W. G. Thorpe, del

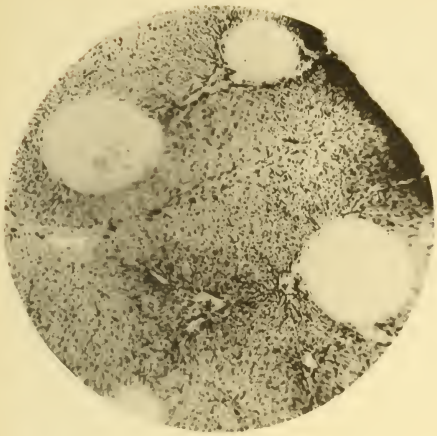
Collotype by Morgan & Kidd, Richmond.

THE ROTIFERA OF CHINA.



V.G. Thorpe, del.

Collotype by Morgan & Kidd, Richmond



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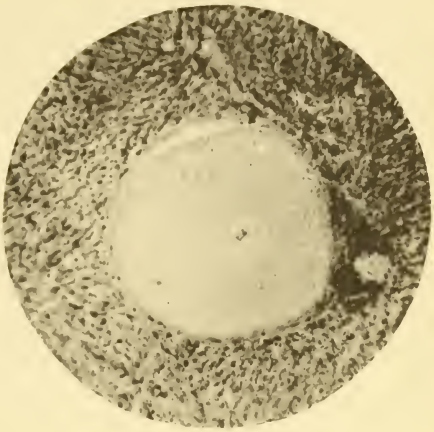

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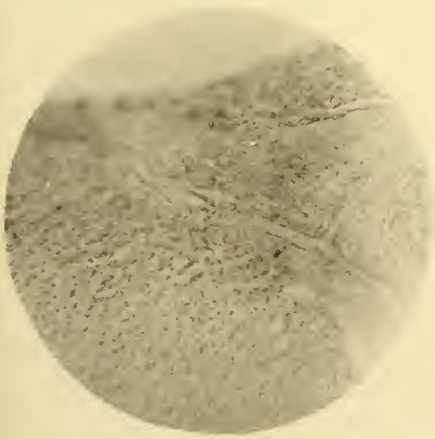

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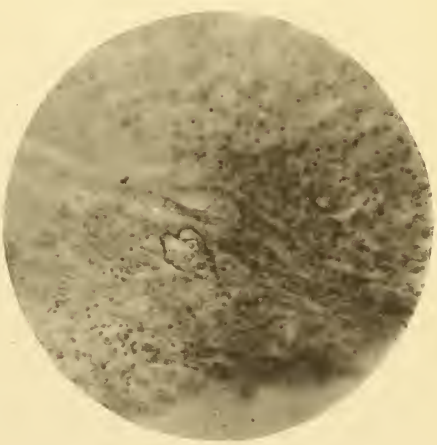
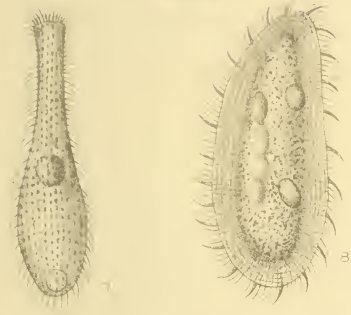


5

G. M. Giles Photo.

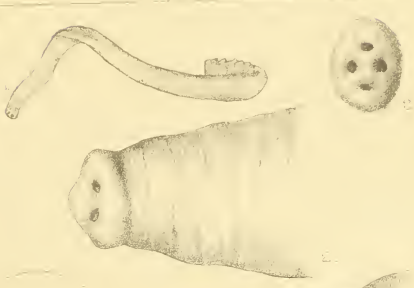
Collotype by Morgan & Kidd, Richmond.

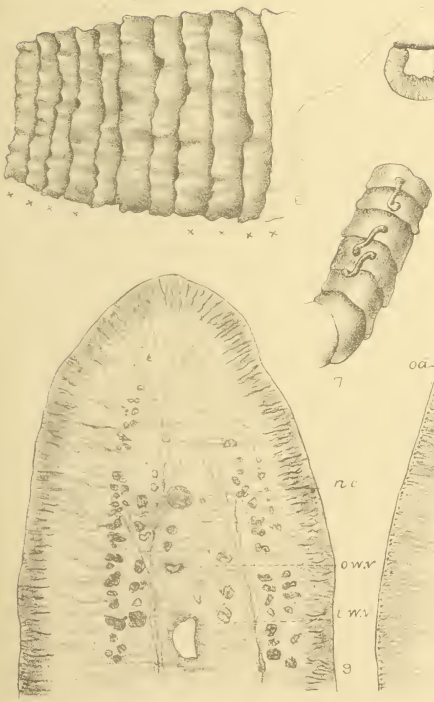
CYSTIC WORMS SIMULATING TUBERCULOSIS.

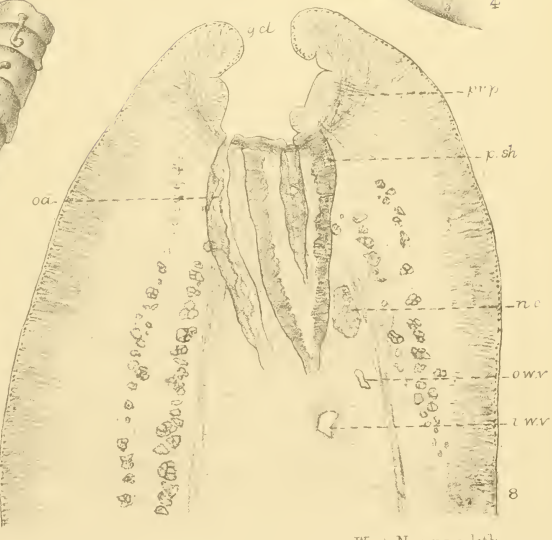


New Infusoria from the United States.

A. Schmidt del.







W.T. Cad nat del

Tænia Echidnæ.

West, Newman lith