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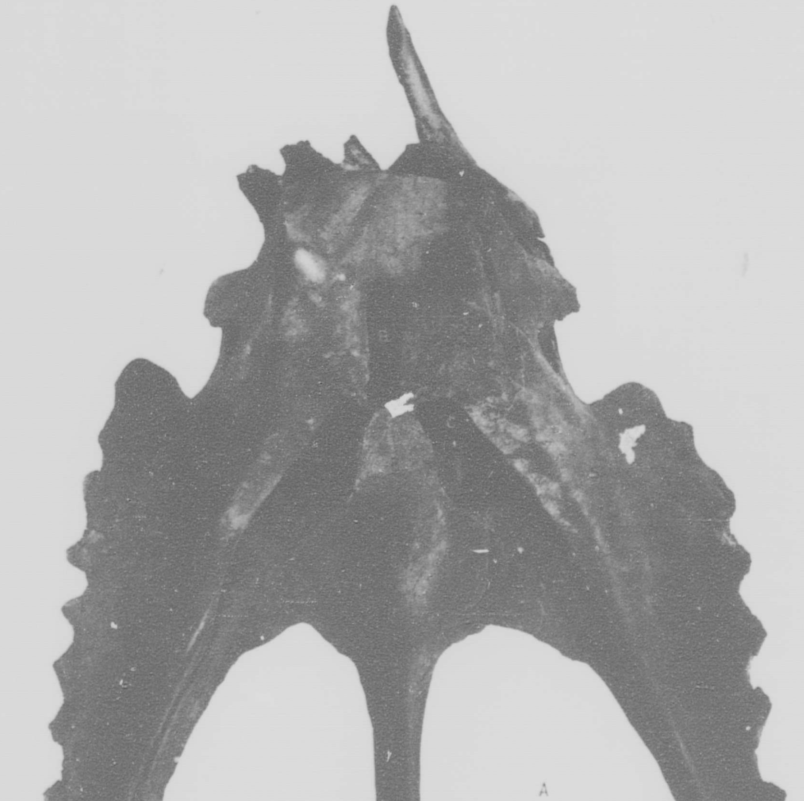
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THE OTTAWA NATURALIST

VOL. XXVII. February, 1914 No. 11

ON *GRYPOSAURUS NOTABILIS*, A NEW GENUS AND SPECIES OF TRACHODONT DINOSAUR FROM THE BELLY RIVER FORMATION OF ALBERTA, WITH A DESCRIPTION OF THE SKULL OF *CHASMOSAURUS BELLI*.*

BY LAWRENCE M. LAMBE, F.G.S., F.R.S.C., F.G.S.A.,
Vertebrate Palæontologist to the Geological Survey, Canada.

In two papers lately published the writer has described some of the dinosaurian material included in the 1913 collection, made by the Geological Survey's vertebrate palæontological party in the Belly River formation on Red Deer river, Alberta, under Mr. Charles H. Sternberg.

The present paper is descriptive of a skull representing a new genus and species of trachodont, and of that of *Chasmosaurus belli*, both forming part of last summer's collection.

The skull of the trachodont is remarkable for its splendid state of preservation. The elements composing it are singularly free from breaks and displacement, there is little or no distortion, and the specimen is as close an approach to perfection as can be expected in a fossil vertebrate of large size.

With the skull were found about twenty feet of the vertebral column, most of the pectoral arch, about half of the ribs, the pelvic arch, one hind limb with part of the foot, and impressions of the skin from between the femur and the base of the tail. The discoverer of these remains was George F. Sternberg, who has also prepared the skull as shown in side view, on plate XVIII.

For the genus and species represented the name *Gryposaurus notabilis* is proposed, the generic term having reference to one of the most striking features of the skull, viz., the prominence attained by the upper marginal curve of the nasal bones.

The genus may be defined as follows:—Skull large, narrow and very deep, with highly arched nasals. The lower anterior border of the premaxillæ expanded laterally. Orbit much smaller than the lateral temporal fossa. Quadrate high, partially

*Communicated by permission of the Director of the Geological Survey.

separated from the jugal by a small quadrato-jugal. Mandible robust. Predentary expanded laterally and deflected in its hinder half, and posteriorly bifurcated below at the midline. Neural spines of the anterior dorsal vertebræ long. Ischia not expanded distally. Body covered with small, polygonal, non-imbricating, tuberculate scales of rather uniform size.

In no other member of the Trachodontidæ is the skull so deep anteriorly as in *Gryposaurus notabilis*. The nasals rise to an extraordinary height a short distance in advance of the orbits. The top of the curve of the nasals is as high as the highest point of the back of the skull, viz., the summit of the squamosal behind the supratemporal fossa. The depth of the head at the apex of the nasal bones is equal to about half the maximum length of the skull.

For the present, the characters of the species will be taken for the most part from the skull.

Viewed from the side, the superior outline of the head is most depressed above the front border of the orbit, rising abruptly forward by a short ascent to the summit of the nasals, whence it descends rapidly to the anterior end of the premaxilla in a long curve whose general convexity is broken by a slight dip at midlength. From above the orbit the outline slopes gradually upward to attain the highest posterior point of the dorsal surface of the head a little in advance of the upper end of the quadrate.

Seen from above, the broadest part of the head is along the surface of the jugal beneath the lateral temporal fossa, whence it contracts upward to the dorsal surface and forward to a point beneath the hinder end of the nasal opening, to expand again to a moderate extent in the lower premaxillary border.

In the dorsal surface of the skull there is a slight diminution in breadth from behind the orbits backward, a somewhat equal contraction forward above the orbits, continued in a much greater degree, in the front half of the skull, by the narrow median elevation of the nasals and premaxillæ.

The sutures in this skull are so distinct that the position, shape and connections of the various elements composing it can be readily understood by reference to its photographic representation in lateral aspect in plate XVIII.

The narial opening is extremely long and narrow. It is enclosed behind and mostly above by the nasal, and in front, and for the greater part below, by the premaxilla.

The orbital opening is higher than wide, somewhat quadrangular in outline, and narrower below than above. The upper rim is formed equally by the prefrontal and postfrontal, and has a rugose surface. In the rim between these bones is what appears to be a small separate bone, which is regarded as a supraorbital. The slender postorbital bar is formed by a process sent down from the postfrontal to meet one rising from the jugal. The opening is bounded beneath by the jugal, and in front by the prefontal, lachrymal and jugal. In the upper anterior part of the opening there is a conspicuous emargination of the rim bounded in front and above by the prefontal and below by the lachrymal which sends up a short, stout process from its posterior border behind the emargination. What appears to be the opening of the lachrymal canal is here visible within the indentation.

The lateral temporal fossa is more than twice as high as wide and is narrowly rounded at its front lower termination. It is bounded in its lower half by the jugal, and in its upper half by the postfrontal anteriorly, by the postfrontal and squamosal above and by the squamosal and quadrate posteriorly. The jugal connects with the quadrate for some distance above the upper end of the quadrato-jugal.

Anteriorly, the jugal effects a strong union with the maxilla below and the lachrymal above. The lachrymal meets the maxilla below in advance of its union with the jugal and connects with the nasal for a short distance, separating the prefontal from the long, backwardly directed lower limb of the premaxilla.

The nasal extends back as far as the posterior end of the postfrontal and meets the frontal in a coarsely dentate, transverse suture. The frontal is about as broad as long and does not reach the orbital rim. Antero-laterally this bone connects with the postfrontal and supraorbital, postero-laterally it is met by the postfrontal and behind by the parietal. The naso-frontal surface between the eyes is flat and at a slightly lowel lever than the upper orbital rims.

The supratemporal fossa is angularly oval, with the greater diameter fore and aft. It is enclosed in front about equally by the parietal and postfrontal, and on the outside by the postfrontal and squamosal. The frontal does not quite reach the anterior margin of the fossa. The squamosal passes inward behind the opening to meet the parietal, but to what extent the latter bone contributes to the formation of the posterior border is not known, as the position of the squamoso-parietal suture has not yet been determined. The coalesced parietals form a narrow median bar, separating the two openings.

Viewing the skull from the side, the thin edge of the angular is visible for a short distance beneath the posterior end of the dentary, and the articular appears to a limited extent at the extreme end of the mandible above the surangular. This last bone, which supplies the greater part of the cotylus for the articulation of the quadrate, is stout and ascends in front against the back surface of the coronoid process.

The teeth are of the usual trachodont type and are in from two to three rows in the grinding surface of the lower jaw. A satisfactory examination of the inner enamelled surface of the lower teeth has not been possible, but in two of the teeth seen from the inner side, the margin appears to be smooth, or nearly so.

The edentulous part of the dentary is short and decurved and is covered in front for a little more than half of its length by the predentary.

The front margin of the premaxillæ, for a distance of 2¼ inches on each side of their median sutural union, is notched in a regular manner. On each side of the dentate edge the margin curves concavely upward and then merges into the extensive, depressed, lateral expansion.

Superiorly, the predentary conforms to the shape of the premaxillaries. Its antero-lateral border rises on each side of a sunken median portion which would receive the notched end of the premaxillaries if the jaws were brought together. Postero-laterally, the predentary expands outward, producing a surface which is concave above and conforms to the shape of the lower surface of the lateral premaxillary expansion. This concave surface terminates outwardly behind in a short pointed process. Antero-laterally, the bone is excavated beneath the border of the upper surface. The retreating lower median surface ends posteriorly in two processes, one on each side of the symphysis, the anterior end of the dentaries being excavated to receive them. These processes are longer than broad and thin vertically. The predentary is one-third the length of the dentary and one-fourth that of the complete lower jaw.

The skin impressions found with the skeleton to which this skull belongs are natural moulds and casts from the hinder part of the body between the femur and the base of the tail. The impressions are of non-imbricating, polygonal scales, smooth and convex on the upper surface, and varying in diameter from ⅛ up to ⅜ of an inch, with an average breadth of about $\frac{3}{16}$ of an inch. In the considerable integumental area revealed, the scales vary in size between the above limits without any definite pattern arrangement.

It may be found by further study and comparison that the Belly River species *Trachodon selwyni*, established by the writer in 1902,* principally on the evidence of teeth, is the same as

*Contributions to Canadian Palæontololgy, vol. III (quarto), pt. II.

Gryposaurus notabilis, in which case the species would be known as *Gryposaurus selwyni*.

MEASUREMENTS.	Feet.	Inches.
Height of head from lower edge of dentary to highest point of nasal.	1	7½
Height of same from lower edge of surangular to highest point of squamosal.	1	8
Length of same from anterior end of premaxilla to posterior edge of squamosal	3	3
Breadth between upper rim of orbits.		9⅜
Breadth between expanded lower anterior border of premaxillæ		9½
Length of lower jaw, including predentary.	2	3⅜
Depth of lower jaw at midlength from outer alveolar border to lower edge of dentary.		5½
Height of quadrate.	1	4⅝
Length of dental grinding surface of lower jaw in advance of the anterior margin of the coronoid process.	1	0
Breadth of same at midlength.		1 3/16
Length of supratemporal fossa.		6
Width of same		4
Height (oblique) of lateral temporal fossa.		11⅝
Width (horizontal) of same at midheight.		5½
Height (oblique) of orbital opening.		8⅜
Width (horizontal) of same		5
Length of nasal opening	1	0½
Width of same at midlength.		2½
Greatest length of premaxilla from front margin to termination above lachrymal.	1	9⅛
Greatest length of predentary.		8
Length of nasal, in a straight line.	1	7⅞
Length of frontal at midline of head.		3⅝
Max. breadth of same.		4⅜
Length of coalesced parietals (approx.)		7¾

Last summer Mr. Sternberg's party on Red Deer river was fortunate in discovering also a fairly complete skeleton with the skull, including skin impressions, of *Chasmosaurus belli*, a species founded by the writer in 1902,* on part of the coalesced parietals, and at that time assigned by him to the genus Monoclonius. The characters of the skull have revealed a new generic type, for which the name Protorosaurus** has lately been proposed.***

*Contributions to Canadian Palæontology, vol. III (quarto), pt. II

**The Ottawa Naturalist, vol. XXVII, No. 10, January, 1914

***See foot-note, p. 155

The lower surface of the skull has not yet been freed from the matrix, and the remainder of the skeleton is also in the state in which it was brought from the field and awaits description, but the skin impressions found with the remains of this individual have been described and figured by the writer in the paper above mentioned, in which the genus Chasmosaurus is defined.

When found, the front part of the head above and in advance of the midlength of the maxillaries had gone to pieces through weathering, as had also the left side of the face as far back as the outer margin of the squamosal. The plane of weathering had not reached the rami of the lower jaw, which are present, but the predentary is missing. The large squamoso-parietal frill is in a particularly excellent state of preservation. On the right side the orbit and jugal are intact, and both supraorbital horn-cores are present. This specimen was found with the dorsal surface uppermost, in a bed of clayey sandstone impregnated with iron. It has apparently suffered little distortion. The right jugal is pressed outward to some extent, and the squamosals, particularly toward their outer border, appear to be less inclined downward than they should be. The mandibular rami, as also the right quadrate and quadrato-jugal, were slightly displaced, but without distortion.

The genus Chasmosaurus is regarded as ancestral to Torosaurus of Marsh from the Laramie of Wyoming, U.S.A. Its main characters, as already defined, are as follows:—Skull large, broadly triangular in superior aspect, with a narrow, abbreviated facial portion, and a broad and greatly extended posterior crest ending squarely behind. Coalesced parietals forming a slender framework enclosing large sub-triangular fontanelles. Squamosals very long and narrow with a scalloped free border. Epoccipitals present. Supraorbital horn-cores small, upright. Supratemporal fossæ of moderate size. Postfrontal fontanelle present. Jaws robust. Teeth large, of the ceratopsian type. Body covered with non-imbricating, small plate-like, and smaller tubercle-like scales.

In this skull of *C. belli*, discovered by Mr. Charles H. Sternberg, the length is 1½ times the breadth, the distance forward of the anterior end being given with a fair degree of accuracy by the mandibular rami. The very great size of the crest or neck-frill, as compared with the rest of the head, is one of the most striking features of the skull, the length of the former to that of the latter being in the proportion of about 2½ to 2. The frill is almost square, while the abbreviated facial portion narrows rapidly to the front.

The crest, composed of the coalesced parietals and the squamosals, is remarkably flat; it extends backward and laterally in almost a horizontal plane. Its length is to its breadth in the proportion of about 7 to 8, with the maximum breadth near the posterior border. The parietal portion, which forms more than half of the frill, is broadly triangular in shape with the apex of the triangle in front. The squamosals are narrowly triangular, broadest in front, and extend backward to within a short distance of the crest's postero-lateral angulation.

Within the coalesced parietals are two sub-triangular fontanelles, longer than wide, and narrowing to the front, and so large as to reduce the posterior two-thirds of the parietals to a mere slender framework consisting of a median longitudinal shaft, separating the openings, a transverse posterior bar enclosing them behind, and narrow lateral bands forming their outer margins.

There are seven low, sub-conical epoccipitals on the lateral free border of the right squamosal, eight apparently on the left, and one, with a greater proportionate height, at each side of the parietal portion on its postero-lateral angle. These separate ossifications have a lengthened oval or lenticular basal outline, the greater diameter being fore and aft, and the under surface is excavated. They are in shape similar to the epoccipitals of Triceratops and are applied to and cover the convexities of the sinuous margin of the frill in a like manner. Of the series the parietal one is the largest and there is a gradual diminution in size forward. Of the five horned dinosaurs known from the Belly River formation of Alberta, the present species and *Centrosaurus apertus* only have epoccipitals.

The parietals in advance of the fontanelles form a broad surface, flat throughout, except along the median line, where there is a low, rounded ridge which, becoming more pronounced toward the front, terminates anteriorly in a small but well defined upwardly inclined platform which reaches the level of and effects a union with the postfrontals. This platform comes to a sharp edge laterally, where it is undercut by the supratemporal fossæ in a somewhat similar fashion as, but to a less extent than, in Centrosaurus and Styracosaurus.

The longitudinal parietal shaft is oval in cross section with the greater diameter transverse. The posterior transverse bar is bow-shaped, bending slightly backward on each side of the median line and curving rapidly forward at each end to form the postero-lateral angle of the frill. On its upper surface there is a narrow ridge along the curved posterior border, and also a similar thickening on the back margin of each fontanelle. The main upper surface of the bar between the ridges is shallowly excavated.

The squamosal of Chasmosaurus is remarkable for its length, although in comparison with the total length of the head it is shorter than in *Torosaurus gladius*, Marsh of the Laramie. It is transversely concave throughout its length and from near the squamoso-parietal suture slopes downward and outward with a slight upward flare at the free border. Anteriorly, it effects a long sutural junction with the postfrontal and is overlapped by the jugal. It encloses the lateral temporal fossa behind and throws forward a process which forms the greater part of the lower margin of this opening. Its front free border is at right angles to the length of the bone and constitutes the back border of a well defined quadrate notch. Its antero-lateral angle is evenly rounded. Behind its union with the postfrontal its superior surface is broadly rounded transversely and descends rapidly backward to the general level of the parietal portion of the frill. Behind the jugal its surface is almost vertical. In its hinder half the broad front elevation is continued backward as a narrow ridge next to the squamoso-parietal suture. Anteriorly within it overhangs the opening of the supratemporal fossa.

In lateral aspect the jugal is narrow in its lower portion, and evenly rounded at the extremity. Above, it enters into the formation of the lower margin of the orbital rim to some extent. Laterally in front it overlaps the maxilla, and posteriorly above it meets the postfrontal and sends out an extension which forms the front and upper margin of the lateral temporal fossa and overlaps the squamosal for some distance back of this opening. Its posterior border does not assist in enclosing the lateral temporal fossa below, but what appears to be a broken surface on the border beneath the level of the opening suggests a convexity in the outline of the bone at this point. The forwardly directed process from the squamosal beneath the lateral temporal fossa does not reach the jugal and the lower margin of the opening is completed by the quadrato-jugal. Both the quadrate and the quadrato-jugal have been forced out of place, upward, to some extent. A rugose area on the outer posterior surface of the lower end of the jugal suggests that an epijugal may have been present.

The orbit is higher than wide and slightly oblique, with the greater diameter directed downward and forward. The supra-orbital horn-core rises immediately above the eye-opening. It is short and upright, and broadly oval in cross section near the base, with the greater diameter fore and aft. Its basal outer surface is flattened and lies in the same vertical plane as the orbital rim. Behind the horn-core the postfrontal is tumid, and between this convexity and the orbital rim the surface is sunken.

The lachrymal forms the greater part of the front rim of the orbital opening, and meets the jugal below. It is injured anteriorly, and the frontals are not preserved. The postfrontals between the supraorbital horn-cores form a flat surface which slopes downward in front but descends much more rapidly behind. The tumidity of the surface behind the horn-cores merges into the broad anterior elevation of the squamosals. The suture between the postfrontals is not visible in front, but in the midline of the postfrontal surface there is a long, narrow fontanelle which extends back from a point in line with the posterior half of the horns to the anterior end of the raised parietal platform which enters into the formation of the posterior margin of the fontanelle. This opening is rounded behind and in front, and comes to a sharp edge at the margin. Within, the excavation has a smooth floor and extends to each side for some distance beneath the postfrontals.

Three smooth prominences occur in line on the broad anterior ridge of the squamosal, and in continuation there is an indistinct one in advance of the postfrontal suture, the tumid surface behind the supraorbital horn-core being one of the series, and the horn-core itself may be considered as the anterior culmination. In the midline of the coalesced parietals two obscurely marked elevations of a like nature occur in advance of the median shaft.

The coalesced parietals form the floor and side walls of the posterior end of the postfrontal fontanelle, to what extent is not known, but the parieto-postfrontal suture is probably at the anterior end of the narrow surface of bone seen in the superior view of the skull separating the fontanelle from the supratemporal fossa. This entry of the parietal into the formation of the postfrontal fontanelle occurs in both Styracosaurus and Centrosaurus.

The mouth or opening of the supratemporal fossa is rather narrow, and in coming from beneath the postfrontal it deeply undercuts the parietal platform and the squamosal, more especially the latter. The whole of the floor of the fossa at its mouth is supplied by the parietal, the squamoso-parietal suture being at the extreme outer limit of the floor. The sharp overhanging edge of the mouth of the fossa is continuous in its curve and is contributed to by the parietal, squamosal and postfrontal, to a less extent by the last than by the other two elements. In advance of the parietal platform the surface of the bone drops to a slightly lower local level, leaving the anterior termination of the platform sharply defined.

The lower jaw is strong and robust. The depth of the dentary at its midlength, measured from the inner alveolar border, is a little over one-third of its length. The angular enters largely into the exterior surface of the jaw posteriorly, its sutural junction with the dentary having much the same general direction as in *Ceratops canadensis*. Its external surface is much farther forward beneath the base of the coronoid process than in Triceratops. The surangular, articular and splenial are preserved and will be described at a later date. The coronoid process is strong and terminates anteriorly above in a narrowly rounded hook. The height of the alveolar border above the lower margin of the dentary decreases only slightly from front to back, and in this respect the direction of the border differs materially from that of *C. canadensis*, otherwise there is a general resemblance in the mandible of these two species. The lower teeth bear a very high keel, and the grinding surface, as displayed by those teeth which have been in use, is almost vertical.

The dorsal surface of the skull of Chasmosaurus is rather smooth throughout. Small vascular markings occur on the parietals behind the inclined platform and on the platform itself. The upper surface of the postfrontals show these grooves to a greater extent but not in so decided a manner as the supra-orbital horn-cores and the epoccipitals which are the most rugose parts of the skull.

The skull has been prepared, as it appears in the figures, by its discoverer, Mr. Charles H. Sternberg, and his son, Mr. C. M. Sternberg.

MEASUREMENTS.	Feet.	Inches.
Estimated length of skull from midway between apices of parietal epoccipitals to front edge of rostral bone, about	5	5
Length of skull along median line from posterior parietal border to anterior end of dentary	4	7
Maximum breadth of crest	3	$5\frac{3}{4}$
Breadth between centre of orbits		11
Breadth between lower margin of lateral temporal fossæ	1	$6\frac{3}{8}$
Antero-posterior diameter of supraorbital horn-core near base		$2\frac{5}{8}$
Transverse diameter of same near base		2
Length of same, tip restored		$3\frac{1}{2}$
Length of squamosal from front end of process under lateral temporal fossa to back termination	2	$9\frac{3}{8}$
Length of coalesced parietals along median line from posterior border to front edge of raised portion between supratemporal fossæ	2	$6\frac{1}{8}$

Maximum length of intraparietal fontanelle (oblique)	1	8
Width of same	1	$1\frac{7}{8}$
Transverse diameter of parietal shaft at midlength		$2\frac{3}{8}$
Length of lower jaw from back end of articular to front end of dentary	1	$8\frac{3}{8}$
Depth of dentary at midlength from inner alveolar border to lower margin		$5\frac{5}{8}$
Vertical diameter of orbital opening		$4\frac{3}{8}$
Horizontal diameter of orbital opening		$3\frac{5}{8}$
Vertical distance of postfrontal surface between orbits above lower end of jugal	1	$1\frac{1}{2}$
Breadth of crown of tooth of lower jaw		$\frac{5}{8}$
Length of postfrontal fontanelle		$6\frac{1}{4}$
Depth of same anteriorly		$2\frac{1}{2}$
Depth of same posteriorly		3
Height of posterior edge of postfrontal above floor of supratemporal fossa		3

EXPLANATION OF PLATES.

PLATE XVIII.—Lateral view of skull of *Gryposaurus notabilis*, one-sixth the natural size.

PLATE XIX.—Skull of *Chasmosaurus belli*, from above; one-tenth the natural size.

PLATE XX.—Side view of same, similarly reduced.

Abbreviations.—*A*, parietal fontanelle; *AN*, angular; *AR*, articular; *B*, postfrontal fontanelle; *C*, supratemporal fossa; *D*, lateral temporal fossa; *DN*, dentary; *EO*, epoccipital; *FP*, postfrontal; *J*, jugal; *L*, lachrymal; *MX*, maxilla; *N*, nasal; *NO*, nasal opening; *OR*, orbit; *PD*, predentary; *PF*, prefrontal; *PM*, premaxilla; *Q*, quadrate; *QJ*, quadrato-jugal; *S*, squamosal; *SA*, surangular; *SO*, supraorbital.

NOTE.—The fact that the generic term Protorosaurus is already in use was overlooked by the writer, who now substitutes Chasmosaurus to designate the Belly River ceratopsian from Alberta. The new name has reference to the openings in the skull, more particularly to the great size of the intraparietal fontanelles.

SALIX HOOKERIANA BARRATT.

This willow, so abundant in low ground and swamps in the Lower Fraser Valley and on Vancouver Island, is, I think, not understood by the makers of books on the flora of Washington State, or perhaps the plant reaches fuller development in British Columbia. The capsule is very variable in its indument, being either densely tomentose, quite glabrous, or glabrous below or on the sutures and tomentose above, sometimes becoming nearly glabrous in this intermediate form. According to Hooker's description and figure the capsule is glabrous; but glabrous forms are not so common as tomentose. They occur both on the mainland and on Vancouver Island.

S. Hookeriana flowers at Vancouver in March, shortly after *S. Scouleriana*, from which it is easily distinguished by its furry-tomentose branchlets, which are very brittle at a point just above the fork; by its long style and short stigmas, and by its usually very large, erect, fertile catkins. *S. Scouleriana* has little or no style, long stigmas, merely puberulent branchlets and the fertile catkins soon recurve. The staminate catkins of *S. Hookeriana* are larger than those of *S. Scouleriana*, and sometimes in two sets—the second set not flowering for a month or six weeks after the first, when apparently no late pistillate catkins are in flower. It rarely produces stipules, a point about which Hooker was doubtful.

The closest allies of *S. Hookeriana* in British Columbia seem to be *S. Barrattiana* of the Rockies, which always has large stipules, and *S. Piperi* Bebb, if a few clumps occurring at Vancouver can be so assigned. These clumps have large, oblong leaves shining above and glaucous-pubescent below, and so far agree very well with Bebb's description; but the branches are slightly pubescent, the leaves firm rather than thin, and the capsule may have a very slight pubescence at the apex. The willow is thus, as far as the pistillate plant is concerned, intermediate between the form of *S. Hookeriana* with glabrous or slightly pubescent capsules, and *S. Piperi*. The staminate flowers have not been observed.

In the autumn form this willow quite differs from *S. Hookeriana*. Its leaves turn yellow, and fall late; while those of *S. Hookeriana* turn more or less blackish, and fall earliest of the coast willows. As the type of *S. Piperi* came from Seattle, this species may be expected to occur in southern British Columbia.

J. K. HENRY, VANCOUVER, B.C.

MEETING OF THE BOTANICAL BRANCH.

Held at the University Club rooms, 150 Elgin Street, on the evening of January 17th, the following members being present: E. D. Eddy, R. B. Whyte, L. H. Newman, C. J. Tulley, T. W. Dwight and J. R. Fryer.

Mr. L. H. Newman led in the discussion of a review of some recent work dealing with the phenomenon of variation in plants. He first reviewed some work done by Fruwirth on potatoes. Fruwirth investigated the variations occurring in successive generations of potatoes. In order to eliminate variations due to hybridization he sowed seeds taken from potato balls grown naturally, that is, no artificial crossing had been practised in producing this seed. After the first generation each succeeding one was produced from the tubers and not the true seeds of the preceding. Careful comparisons were made between the mothers and their respective progeny in different generations in order to observe and record any apparent deviation that might occur. Special attention was given to the colour of the skin and of the flesh of the tubers harvested, together with the size and shape of these. The variations in these features were very marked. Most of them were readily explainable by the principles of heredity, but in one case there were found in the second generation four plants which produced yellow-fleshed tubers, although the flesh of the mother sort was not yellow, but white. This form cannot be explained as recessive because yellow was dominant. No very satisfactory explanation was given for this occurrence. From the results of his investigation Fruwirth concludes "that it is possible to improve our present potato sorts by the continuous selection of desirable hills."

Mr. Newman then discussed briefly variations in pure lines of self-fertilizing plants. He stated that recent work indicates that in plants which are normally self-fertilizing there is practically no variation. While it seems certain that we must abandon the idea of the existence of continuous variation in certain classes of plants, yet we know from experience that strange forms do sometimes occur even in our so-called "pure" lines. While the appearance of many of these strange forms may be accounted for as crossing products, it has not been definitely proven that new forms cannot arise quite independently of intersexular combination. Forms appearing in this way have been termed "mutants" or "mutations" by DeVries, who believes that most new forms arise in this sudden independent fashion.

The speaker then reviewed an account published last year by Dr. Kiessling, of Bavaria, on an elaborate investigation into the origin of a form of two-rowed barley, which seems to show that this form is undoubtedly a mutation. In 1898, Dr. Kiessling obtained a sample of old Austrian barley from a farmer and tested it at the breeding station at Weihenstephan. From the crop of 1900 a number of plants were selected for pure line work. One of these survived the test and came to be propagated in a pure condition from year to year. In 1908, eighteen plants were selected out of this line to prove its constancy. The progeny from each of these plants proved to be constant with one exception. In this case the plants, on May 10th, were recorded as being somewhat less upright than those in the other cultures. The plants thus deviating were closely studied and their progeny carefully compared from year to year with the progeny of the original pure line. In 1911, it was found that the aberrant type was much more susceptible to cold than was the original mother line. Other evident differences between the two showed conclusively that a new form had arisen. Moreover, the new form showed its own modification curve, and therefore cannot be regarded as a modification of the original line. After much discussion as to an explanation of the origin of this new form Kiessling finally concludes the new type is an example of DeVries mutations.

J. R. F.

NOTES ON THE APOTHECIAL STAGE OF SCLEROTINIA CINEREA IN ONTARIO.

By J. E. Howitt, O.A.C., Guelph, Ont.

This fungus was known as *Monilia fructigena*, Pers., until placed in the genus *Sclerotinia* by Woronin in 1899. Recent investigations show that the American Brown Rot fungus of stone fruits is not identical with *Sclerotinia fructigena* occurring in Europe on pome fruits. It agrees more clearly with *Sclerotinia cinerea* and should be referred to that species. In the spring of 1902, Norton found the apothecial stage in abundance in peach and plum orchards in Maryland. In 1906, this stage was reported as being very common in the United States throughout the west. Up to the present time, however, pathologists have not regarded the apothecial stage of importance in the propogation of the fungus. Conidia adherent to bark or bud scales and the mycelium of the mummied fruits or blighted twigs have been considered to be the chief sources of infection. While these are undoubtedly important sources of infection, observations made by the writer during the spring of 1912 point to the possibility that in wet seasons the apothecial stage may be of primary importance in the dissemination of the fungus and the chief source of blossom infection.

In the course of some studies on the life-history of *Sclerotinia cinerea* a careful watch was kept for the appearance of the apothecial stage. On May 25th, 1912, Mr. W. A. McCubbin, my colleague in this work, found numerous apothecia under wild plum trees (*Prunus americana*) at Cedar Mills, Ontario. The soil in this locality is a sandy loam. Apothecia were produced from old plums buried from one to two inches in the sand and loam. These old plums had evidently been buried for some time in the soil, as last year's plums were still on the surface of the ground. When the apothecia were gathered it was observed that the asci in the more mature ones were discharging their spores. The blossoms at this time had nearly all fallen.

On May 29th, the writer paid a visit to Fruitland, in the Niagara district, Ontario, in search of the apothecial stage. A well cultivated plum orchard (chiefly Lombards) was visited. The soil was a fairly heavy clay loam. Numbers of apothecia were found growing from sclerotia in old dried mummied plums covered by moist earth or lying on the surface of the ground in low spots where water had lain for some time. A closer examination revealed the stipes of numerous apothecia that had evidently withered up as soon as the mummied fruit from which they were growing had been dried by the sun. In another plum orchard, the soil of which varied from clay loam to light sandy loam, many more apothecia were observed, and countless withered stipes indicated how prevalent the apothecial stage had been. When the apothecia were disturbed, the spores were discharged in fine brown dust-like clouds. The petals by this time had nearly all fallen but most of the calices were still intact.

A peach orchard on light, sandy loam was next inspected. In this orchard a heavy cover crop of winter rye was growing. Very few mummied fruits were found on the serface of the soil A number of apothecia were found, however, growing from the mummies buried in the sand. These were most abundant where the cover crop was heaviest and the soil dampest.

This was the first year that the apothecial stage was observed in Ontario. The continual wet weather during May without doubt accounted for the abundance of this stage of the fungus. It was observed that the apothecia were not produced except after heavy rains, and that they dried up and disappeared within a few hours after the weather became dry and warm. The very brief duration of the apothecia probably accounts for the fact that this stage has not been more generally observed by pathologists.

On the same dates that the apothecia were found in such abundance, mummied fruits and blighted twigs were examined to see if the mycelium was producing spore pustules. Though large numbers of mummies and twigs were examined none showed signs of spore pustules. These were not observed until a much later date. As the blossoms had nearly all fallen at this time, it would appear that the source of blossom infection is either conidia adherent to the bud scales or the apothecial stage produced from mummied fruits beneath the trees. It would seem from the observations made that large numbers of apotheica are produced in wet seasons and that the asci discharge immense numbers of spores during the blossoming period. It is, therefore, reasonable to suppose that the apothecia are one of the chief sources of blossom infection which later may result in twig blight. It is also possible that the ascospores account for much of the infection of the young fruit. It also seems likely that the apothecia are produced in more or less abundance every spring, but as they wither very quickly when the weather becomes dry they have not been observed, and hence the apothecial stage has been regarded of little importance in the propagation of the fungus and the continuance of the disease.

The writer hopes to continue these observations, as it is desirable to ascertain definitely the extent of the infection due to the production of apothecia in order that proper measures may be recommended for the control of this disease. Plowing under the mummied fruits has hitherto been considered one of the best means of preventing infection but if the apothecia are produced from old fruits which have been buried a year or more in the soil and brought to the surface by fresh plowing, this method would appear to be of little value.

Observations on this fungus were continued in the spring, of 1913. The apothecial stage was found in comparative abundance in plum orchards near St. Catharines. In order to determine whether the apothecia developed from mummied plums which had been buried in the soil for a year or more, or from mummied plums of the previous season, a number of mummied plums gathered in the spring of 1912 (the plums having been destroyed by the Brown Rot during the summer of 1911) were buried in loam and sand at different depths and left outside, exposed to clim. :ic conditions until the spring, of 1913. They were then dug up and placed in moist chambers. Not a single apothecium developed from any of them nor were there any ones of the formation of sclerotia. Some mummied plums gathered last spring, which had hung on the trees or lain on the ground under the trees for the winter, were placed in moist chambers at the same time. On one mummied plum which had lain on the ground for the winter, a number of stunted, poorly-developed apothecia appeared. This experiment, though by no means conclusive, suggests that the apothecia may be developed from mummies of the previous years. These experiments and observations will be continued with the hope of clearing up this and other obscure points in the life-history of *Sclerotinia cinerea.*

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