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ON THREE INCOMPLETE ANTHROPOID JAWS FROM THE SIWALIKS, INDIA

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One of the important results of the Museum expedition to the Siwalik Hills, India, under the senior author, was the discovery by him of three incomplete fossil anthropoid jaws in the Lower, Middle and Upper Middle Siwalik horizons respectively. One of these jaws has the symphyseal region and the premolars in excellent preservation, and the other two have the cheek teeth nearly perfect, so that taken together they constitute a significant addition to our knowledge of the rare Siwalik anthropoids. The specimens, coming from three well-separated horizons, represent as many successive stages in the differentiation of the premolars from a simpler, more compressed form toward a more bicuspid-like condition. These jaws are also of exceptional interest, because of the additional evidence they afford for the close kinship of the Indian anthropoids, not only to the existing great apes but even to the forerunners of man.[1]

The Museum and the senior author are under deep obligations to Doctor Guy E. Pilgrim of the Geological Survey of India, as well as to other Indian government authorities, for their courteous welcome and valuable assistance, and to Mrs. Henry Clay Frick, whose generous support has met the entire cost of the expedition.

Dryopithecus pilgrimi,[2] new species

TYPE.—The anterior part of a lower jaw (Amer. Mus. No. 19411), including the symphysis, the alveoli of the incisors, the lower part of both canines and the premolars of both sides; also one condyle.

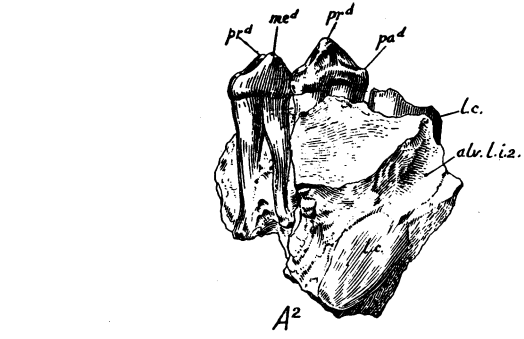
LOCALITY AND GEOLOGICAL HORIZON OF TYPE.—Two miles east of Rammagar, Jammu State, Kashmir. Lower Chinji zone, Lower Siwalik (Middle Miocene).

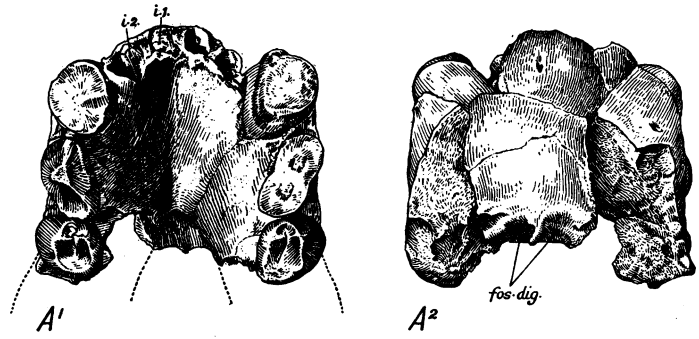
SPECIFIC CHARACTERS.—First lower premolar[3] compressed, but with angulate junction of anterior lingual and buccal surfaces, crown lower than in *D. fontani*,

[1] Cf. Pilgrim, Guy E. 1915. "New Siwalik Primates and their Bearing on the Question of the Evolution of Man and the Anthropoids." Rec. Geol. Surv. India, XLV, pp. 1–74. Also Gregory, W. K. 1916. "Phylogeny of Recent and Extinct Anthropoids with Special Reference to the Origin of Man." Bull. Amer. Mus. Nat. Hist., XXXV. The Indian anthropoids are discussed on pps. 293–301, 336, 337.

[2] Dedicated to Doctor Guy E. Pilgrim, D.Sc., F.G.S., in recognition of his signal contributions to the paleontology and stratigraphy of the Siwaliks.

[3] Hereafter called p_3, it being the homologue of p_3 of the primitive Eocene primates.





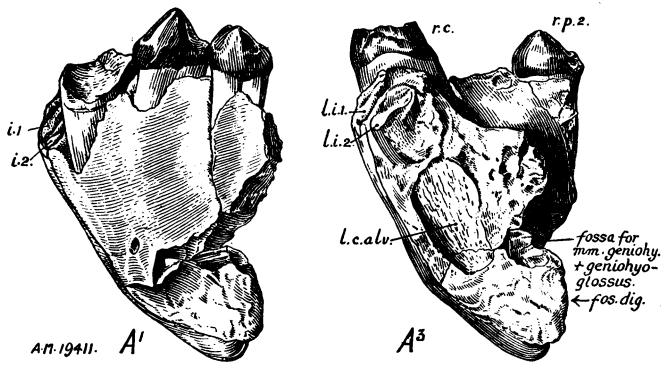


Fig. 1. *Dryopithecus pilgrimi.* Type, A. M. No. 19411. Natural size.

A1. Anterior part of lower jaw, outer view.
A2. Portion of left half of same, medial view.
A3. Portion of right half of same, showing longitudinal section to the left of the mid-line.

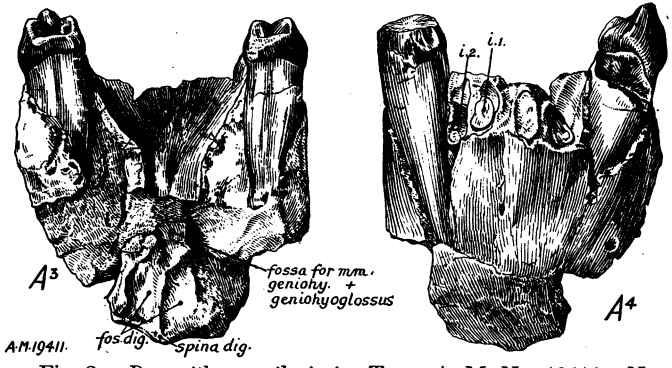


Fig. 2. *Dryopithecus pilgrimi.* Type, A. M. No. 19411. Natural size.

A1. Anterior part of mandible, viewed from above (at right angles to assumed plane of cheek teeth).
A2. The same, viewed from below.
A3. The same, viewed from the rear.
A4. The same, viewed from the front.

buccal convexities more pronounced, lingual cingulum pronounced in anterior half, continued to posterior end, not interrupted by very faint beginning of the metaconid. Fovea anterior represented by a small anteroposterior fissure, talonid fossa incipient, represented by slight depression on posterior slope of enlarged, compressed protoconid. Hypoconid incipient.

P_4 relatively wide with well-developed fovea anterior, anteroposterior sulcus and talonid fossa; hypoconid incipient; entoconid not distinct from limiting ridge; plane of the trigonid less elevated above that of talonid than in *D. fontani;* tips of metaconid and protoconid blunter and more widely separated; external cingulum obsolete or wanting.

Mandible moderately deep and stout, length of symphysis (anterior face), 43 mm. est.; width between opposite canines at base of crown, 35 mm. Digastric area, at bottom of symphysis, vertical, not produced posteriorly into a "simian shelf."

RELATIONSHIPS.—This and the following species appear to be referable to the genus *Dryopithecus*, and they agree with the type species *D. fontani* from the Middle and Upper Miocene of Europe in all fundamental characters of the jaw and teeth. The breadth index of p_3 in the present species is not materially different from that in *D. fontani*. The lesser crown height is associated with the greater convexity of the cusps in the Siwalik specimens, which are thus in this respect somewhat more progressive (i.e., more like the later anthropoids) than is *D. fontani*.

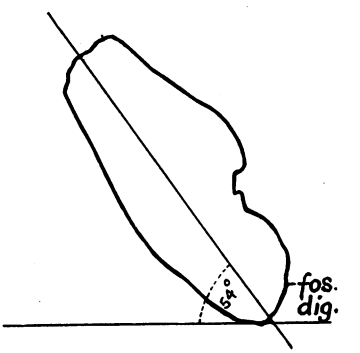


Fig. 3. *Dryopithecus pilgrimi.* Type, A. M. No. 19411. Natural size.

Medial section of the symphysis mandibulæ, showing inclination of symphysis to assumed plane of cheek teeth.

As compared with the p_3, which was referred by Pilgrim (1915, Pl. I, fig. 9) to *Sivapithecus*, that of *D. pilgrimi* is much more primitive and less bicuspidlike, i.e., more compressed and with the anterior part less expanded.

P_4 is relatively wider than in *D. fontani*, especially in the talonid, the anteroposterior sulcus and fovea anterior (trigonid fossa) are more pronounced; the external cingulum, which is distinctly suggested in p_4 of *D. fontani*, is wanting. The front part of the jaw agrees generically with *D. fontani* as well as the longitudinal section of the symphysis.[1]

[1]Cf. Woodward, A. S. 1914. "On the Lower Jaw of an Anthropoid Ape (*Dryopithecus*) from the Upper Miocene of Lérida (Spain)." Quart. Journ. Geol. Soc., LXX, pp. 316–320, Pl. XLIV.

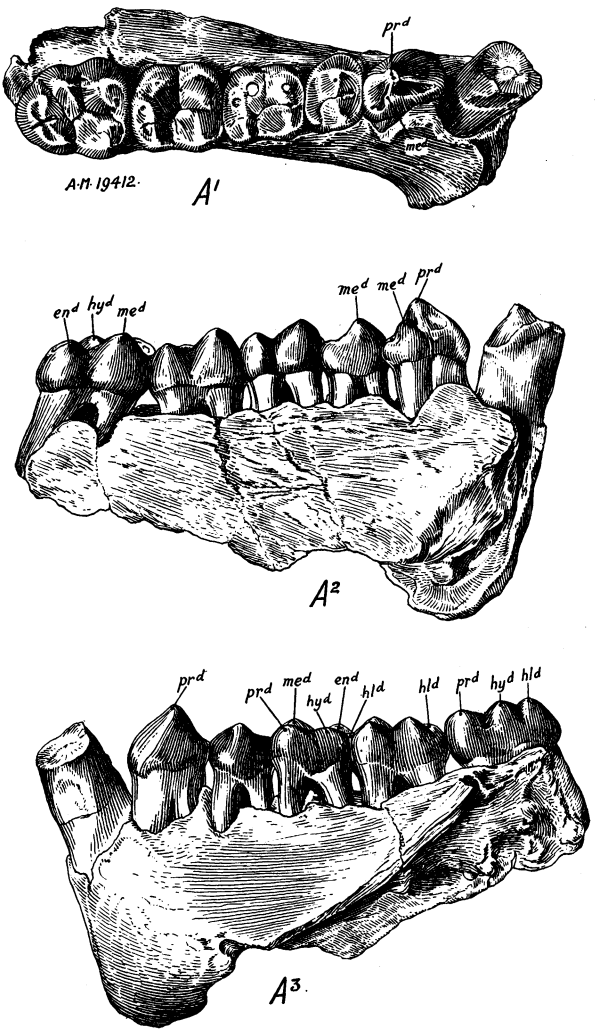


Fig. 4. *Dryopithecus cautleyi.* Type, A. M. No. 19412. Natural size.

A¹. Left branch of lower jaw with cheek teeth, seen from above.
A². The same, inner side.
A³. The same, outer side.

Dryopithecus cautleyi,[1] new species

TYPE.—The left half of a mandible (Amer. Mus. No. 19412) lacking the lower border and symphysis, but including the perfectly preserved cheek teeth and the lower part of the canine.

LOCALITY AND GEOLOGICAL HORIZON OF TYPE.—Four and one-half miles west of Hasnot, one thousand feet below bone bed at Bhandar. Lower levels of Middle Siwalik.

SPECIFIC CHARACTERS.—P_3 slightly wider than in *D. pilgrimi*, anteroposterior cingulum running up posteriorly into a very distinct metaconid which is connected by a crest with the protoconid; fovea anterior a small pit; no hypoconid.

P_4 wider than in *D. pilgrimi*, especially across the talonid, hypoconid at most faintly foreshadowed, anteroposterior sulcus more pronounced than in *D. fontani* and plane of trigonid less elevated above that of talonid; occlusal width between protoconid and metaconid tips greater and cusp points blunter; external cingulum obsolete or wanting; talonid distinctly wider.

Molar series longer than in *D. fontani;* external cingula vestigial or absent, molar cusps more rounded, less pointed; lingual cusps of m_1, m_2 stouter and higher than in *D. fontani*, *D. rhenanus* or *D. punjabicus*. Hypoconulids more central, less visible from the buccal side, than in *D. fontani;* fovea anterior (remnant of trigonid fossa) of m_1, m_2 cleft-like, not as wide as in *D. fontani* or *D. rhenanus*. M_1 distinctly wider than in *D. rhenanus*, trigonid and talonid both wider, fovea posterior slight, sulci between proto- and hypoconid sharply crack-like and limited to summit of crown (in *D. fontani* they form a valley with a rounded bottom); metaconid relatively large (as compared with *D. fontani*). M_2 not nearly as large as in *D. frickæ*.

M_3 with transverse diameters across main cusps diminishing gradually from protoconid to hypoconulid. M_3 intermediate in total width between the relatively narrow m_3 of *D. giganteus*, *D. punjabicus*, *D. rhenanus*, *D. fontani* and the broad m_3 of *D. darwini* and *Sivapithecus indicus*. M_3 much smaller than in *D. giganteus*, larger than in *D. punjabicus*. No accessory cusp on the metaconid, buccal convexities of cusps pronounced, foveæ anterior and posterior conspicuous, entoconid projecting; cusp "6" barely defined. Depth of jaw much greater than in *D. punjabicus*.

RELATIONSHIPS.—The nearest relative of *D. cautleyi* seems to be its contemporary *D. chinjiensis* Pilgrim, known chiefly from a third lower molar (Pilgrim, *op. cit.*, Pl. II, fig. 6). The most conspicuous differences in *D. cautleyi* are the lack of an external cingulum, the smaller size of the tooth, the lesser distinctness of cusp 6 and the absence of cusp 7 behind the metaconid.

D. cautleyi may well be a descendant of *D. pilgrimi*, from which it differs in the distinctly more advanced stage of evolution of the premolars.

Dryopithecus (?) **frickæ,**[2] new species

TYPE.—The left half of a mandible (Amer. Mus. No. 19413) lacking the front part but containing p_4–m_3 in excellent condition.

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[1]Named in honor of Sir Proby Cautley, the first great collector of the ancient Siwalik fauna.
[2]Named in honor of Mrs. Henry Clay Frick, the patroness of the Siwalik Hills Expedition.

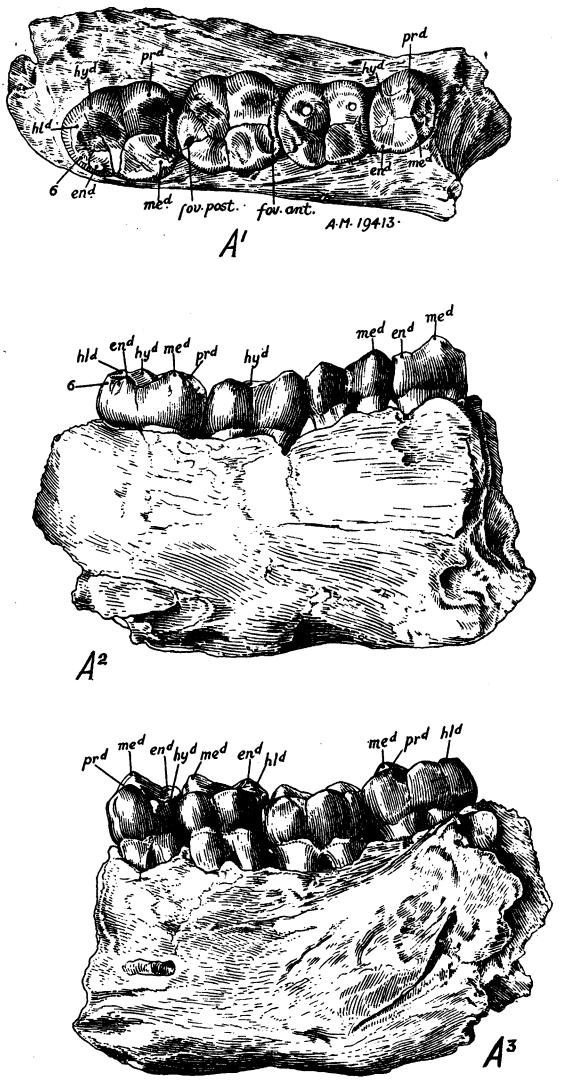

Fig. 5. *Dryopithecus fricke.* Type, A. M. No. 19413. Natural size.

A1. Left branch of lower jaw, containing p_4–m_3 complete, seen from above.
A2. The same, inner side.
A3. The same, outer side.

LOCALITY AND GEOLOGICAL HORIZON OF TYPE.—Middle Siwalik, about level of Bhandar bone bed, or 600 feet below top of series.

SPECIFIC CHARACTERS.—General size distinctly larger than in *D. cautleyi, D. punjabicus, D. fontani;* slightly larger than in *D. chinjiensis.* Jaw very massive, depth in front of m_3, 31 mm., thickness of jaw in front of the root of the ascending ramus, 19 mm.

P_3 widened posteriorly, probably more advanced toward the bicuspid form.

P_4 more advanced than in *D. pilgrimi, D. cautleyi,* a deep notch now separating the hypoconid from the posteroexternal border of the protoconid base, p_4 wider than in *D. fontani, cautleyi* or *pilgrimi,* not as wide as in *Sivapithecus.* Trigonid and talonid basins strongly developed, anteroposterior sulcus cracklike, separating large metaconid from protoconid, entoconid corner prominent.

Molar crowns with enamel folds neither numerous nor pronounced. M_3 larger and wider than in *D. cautleyi, D. fontani, D. rhenanus,* with wide talonid. Cusps of m_1 more rounded, less pointed than in *D. fontani,* slopes more convex, relative height of lingual cusps greater, buccal convexities more pronounced. Sulcus between proto- and hypoconids sharply cracklike, in contrast with the open rounded groove of *D. fontani.* Hypoconulids of m_1, m_2 more central in position, less visible from the outer side than in *D. fontani.* External cingula in molars absent, in contrast with *fontani.* Fovea anterior of m_1, m_2 slitlike, fovea posterior small; entoconid large; m_1 wider than referred m_1 of *D. chinjiensis,* hypoconid less protruding buccally. M_1 wider, with wider talonid than in type of *Sivapithecus indicus,* roots less widely divergent anteroposteriorly; fovea anterior narrower anteroposteriorly, hypoconulid more centrally placed, entoconid larger.

M_2 markedly larger than in *D. cautleyi, D. punjabicus, D. fontani, D. rhenanus.* Buccal convexities pronounced. No accessory cusp (7) behind metaconid (in contrast with *D. pubjabicus*). M_2 narrower than in *Sivapithecus indicus;* hypoconulid larger and more widely separated from hypoconid, external roots less divergent anteroposteriorly.

M_3 larger than in *D. fontani, D. rhenanus, D. cautleyi, D. punjabicus,* width intermediate between the relatively narrow m_3 of *D. giganteus, D. punjabicus, D. rhenanus, D. fontani* and the broad group *D. darwini* and *Sivapithecus indicus.* Relative width of talonid more as in narrow group; m_3 much smaller than in *D. giganteus,* with higher total width index.

M_3 differs from that of *D. chinjiensis* in general contour, which is more narrowing posteriorly, more pronounced convexities of all cusps, thicker enamel cap, more elevated, diagonally recurved metaconid, more robust accessory cusp (7) behind the metaconid; fovea anterior deeper, showing a decided transverse cleft; cusp 6 less well defined; transverse furrow in front of entoconid connecting buccally only with the one in front of the hypoconid, thus not forming a Y-shaped junction defining the hypoconid.

M_3 differs from that of *Sivapithecus* in general contour, which is more elongate and pointed posteriorly, with the hypoconid less protuberant buccally.

RELATIONSHIPS.—*Dryopithecus* (?) *frickæ* may well prove to be a descendant of *D. cautleyi,* from which it differs in the more advanced stage of p_4 and especially in the much larger size of m_2. In this feature it differs also from *D. fontani, D. rhenanus* and *D. punjabicus.* In fact, this

difference is so marked that it leads to the suspicion that *D.* (?) *frickæ* represents a higher generic phase of the *Dryopithecus* line. Mr. Brown in the field referred it to *Palæopithecus*, a form from a slightly later horizon, known hitherto only from a palate figured by Lydekker and by Dubois. We have considered the possibility of approximate occlusion of the lower jaw of *D. frickæ* with the palate of *Palæopithecus sivalensis* and have tried to project the lower cusps into the appropriate loci on the upper teeth. But the wide differences in the state of wear of the upper and lower teeth in the two specimens prevent our obtaining positive correspondence between them, so that in default of further evidence we regard it as more conservative to refer the species *frickæ* to *Dryopithecus*, especially as all the Indian "genera" of anthropoids exhibit the fundamental "*Dryopithecus*" pattern of the molars with minor modifications.

	D. pilgrimi. Type, A. M. 19411. Lower Chinji Zone, Lower Siwalik	*D. cautleyi*. Type, A. M. 19412. Lower Middle Siwalik	*D. (?) frickæ*. Type, A. M. 19413. Upper Middle Siwalik	*D. fontani* Gaudry. Upper Miocene, Europe	*D. fontani* (Woodward). Upper Miocene, Europe	*D. rhenanus*	*D. chinjiensis*. Type m³, referred m₁	*D. punjabicus*		*D. giganteus*	*D. darwini*		*Sivapithecus indicus*	*Sivapithecus indicus*. Referred
Ant. surface p_3 to post. convexity m_3		55.6		52e.										
Ant. surface p_3 to post. surface p_4	18.2	18.2												
Ant. end m_1 to post. convexity m_3		37.2	38.8	32.5e.	33.7									
P_3, ant. post. (mesiodist.)	11.3			11.2										12.6
P_3, transv.	7.2			7.3										9.7
P_3, breadth index: $\frac{\text{tr.}\times 100}{\text{a.p.}}$	63.7			65.1										79.3
P_4, ant. post.	7.8	7.8	9	8.2									8.5	
P_4, transv.	8.7	9.2	10.2	8									9.9	
P_4, breadth index: $\frac{\text{tr.}\times 100}{\text{a.p.}}$	111	118	113	97									116.5	
M_1, ant. post.		10.6	11.5	10.4		11.6	11.4						11.5	
M_1, transv.		9.5	11	9.2		9.5	10						10.5	
M_1, breadth index: $\frac{\text{tr.}\times 100}{\text{a.p.}}$		90	95	88		82	87.3						91	
				r 11.3	*l* 11.2									
M_2, ant. post.		12.6	13.5	11.3	11.2	11	12.2		11.3				12	
M_2, transv.		11.3	12.4	11.3	10.6	10	10.7		10				11.7	
M_2, breadth index: $\frac{\text{tr.}\times 100}{\text{a.p.}}$		89.7	91.8	100	94.6	90.9	87.7		88.5				97.5	
												Abel Cast		
								r 12.8	*l* 11.2	19	13.5	13.5	14.3	14
M_3, ant. post.		13.7	14	11	11.5	13.2	14.7							
M_3, transv.		12.3	12.7	9.2	10	11	12.7	10.6	10	15.3	11.8	12.4	13.4	13.7
M_3, breadth index: $\frac{\text{tr.}\times 100}{\text{a.p.}}$		89.8	90.7	83.6	86.9	83.3	86.4	82.8	89.3	80.5	87.4	92.6	93.7	97.8