

It is evident that the structure of the sacrum at once shows the close affinity of this genus to *Agathaumas*. The description of the sacrum can be applied fully to the sacrum figured by Professor Marsh under the name of *Triceratops*. The description of the fore and hind limbs also agrees very much with that of *Triceratops*, and there is not the slightest doubt that *Monoclonius* belongs to the same family. *Monoclonius* and *Ceratops* are from the same locality, Cow Island, Montana; and the portions of the skull figured by Professor Cope (*American Naturalist*, August, 1889) leave no doubt whatever that *Monoclonius* is identical with *Ceratops*. The elements formerly considered by Professor Cope as episternum represent the parietals. I know and have examined the types of *Monoclonius* and *Ceratops*, and can state that the two forms are not generically distinct. In the April number of the *American Journal of Science* a restoration of *Triceratops* is given by Professor Marsh. I think there is no evidence that the animal had such a long tail as the restoration shows. The post-pubis, the presence of which I had predicted (*American Naturalist*, June, 1890), is not represented. In the February number of the *American Journal of Science* Professor Marsh makes the following remarks about the pubis: "One pubis recently discovered has a short, splint-like process, which may, perhaps, be a remnant of a post-pubic element, although it does not have the position of the post-pubic bone in other dinosaurs." Now, there cannot be the slightest doubt that this process is the same element as in the other *Iguanodontia*, and I do not see that it differs in position. The "splint-like process" is not complete behind, and I predict again that this process extended very much farther behind, just as in the allied *Iguanodontidae*.

One of the characters now given by Professor Marsh to the horned saurians consists in the presence of a pineal foramen. This is evidently a mistake. The foramen described as a pineal foramen has nothing whatever to do, even if it really exists in all the skulls, with the true pineal foramen. This foramen is absent in all *Iguanodontia*, and it certainly would not make its appearance again in such a highly specialized animal as *Agathaumas*. I have nothing to add in regard to the teeth. I repeat, that they have not two true roots (compare the *American Naturalist*, June, 1890). The lumbar of the *Agathaumidae* are not absent, as stated by Professor Marsh, but are simply co-ossified with the sacral vertebrae. The statement that the post-frontals meet in the middle line I take the liberty to doubt.

The *Agathaumidae* (this is the only name which can be given to this group) represents a highly specialized family of the *Iguanodontia* (*Orthopoda*), the nearest allies of which are exhibited by the *Iguanodontidae*.

The *Agathaumidae* contain two forms which are well defined (I neglect here the horned saurians *Crataemus* of the Gosau formation, Austria, of which only fragments are known),—*Agathaumas* Cope, 1872 (*Bison* Marsh, 1887; *Triceratops* Marsh, 1889; *Sterrholophus* Marsh, 1891), and *Monoclonius* Cope, 1876 (*Ceratops* Marsh, 1888). *Polyona* Cope, I think, is also a synonyme of *Agathaumas*.

This result is different from that reached by Professor Marsh, who states in the February number of the *American Journal of Science*, 1891, "The generic names *Agathaumas*, *Crataemus*, *Monoclonius*, and one or two others, have been given to fragmentary fossils which may belong to this group; but these remains, so far as made known, appear quite distinct from those here described" (*Ceratops*, *Triceratops*).

G. BAUR.

Clark University, Worcester, Mass., April 2.

The Shrike.

A PLEASANT article, chiefly concerning the shrike, or butcher-bird,—one of John Burroughs's bright articles,—calls to my mind some questions concerning the food of the shrike. Burroughs says that the shrike kills lizards, toads, birds, etc., by striking them on the head, then eats the brains only, and hangs up the carcass. What for?

Professor A. Newton, in "Encyclopædia Britannica," says the shrike hangs up its prey, or impales it, for greater convenience in tearing the carcass to pieces in order to devour it. I have seen a

shrike's nest *in situ*. Around it hung a beetle, a mouse, a small bird, and a big bumble-bee. All were within reach of the bird as she sat on her eggs. A dart forward of her head brought her beak upon any one of these victims. For what were they hung up? For traps, I venture to suggest.

The shrike, no doubt, strikes its prey on the thin skull-bone. Let us say that instinct teaches that here is the spot most vulnerable for a beak no larger than that of the shrike. The exposed brain presents a soft eatable morsel, and the shrike eats it *en passant*. Then it hangs up its booty, and straightway the decaying carcass attracts insects, blue-flies notably, and thereon the shrike feasts. I believe that the shrike is chiefly insectivorous; and its habit of hanging up plunder, making a kind of larder all about its nest, is to call there plenty of large flies, which can be safely picked off as the bird sits on her eggs. True, the shrike hangs up carcasses far from its nest; but to these carcasses it can return frequently for the flies they have attracted. No doubt the instinct which suggests converting the vicinage of the nest to a shamble will prompt the bird to hang up whatever is killed by it, in the place nearest at hand.

JULIA McNAIR WRIGHT.

Fulton, Mo., April 7.

Iroquoian Etymologies.

In an article in *The American Anthropologist* (vol. i. No. 2) suggesting an Algonquian origin for the word "Iroquois," the writer had occasion to criticise a derivation given to this word by Mr. Horatio Hale, in his "Iroquois Book of Rites." This criticism is as follows:—

"Mr. Hale finds what he believes to be at least a possible origin in the indeterminate form of the Iroquois word *garokwa* ('pipe,' or 'string [error for "portion"] of tobacco'), *ierokwa* ('they who smoke,' briefly 'tobacco people'), the Iroquois being well known to have cultivated tobacco. With reference to this derivation, I am not aware that *garokwa* is used as a verb in any of the Iroquoian tongues. If not so used, it cannot, of course, have an indeterminate form, *ierokwa*; if this form existed, it would mean, not 'they who smoke,' but 'one smokes by which.'"

In the next issue of the quarterly named above, Mr. Hale tried, in "Indian Etymologies," to defend his erroneous derivation which had been called in question by the writer. Among other things equally remarkable, he says, "I have no desire to criticise it, but may be allowed to vindicate my own suggestion from the imputations of ignorance or carelessness, which his objections seem to imply. For this object it is not necessary to claim a profound knowledge of the Iroquois tongue, which is one of the most difficult of languages; but Mr. Hewitt, who has read my volume on the 'Iroquois Book of Rites,' might, perhaps, have reasonably given the author credit for a more careful study of the first principles of the language than he seems willing to suppose. With reference to my suggested derivation of the word from the verbal form *ierokwa* ('they who smoke,' reminding one of 'The Tobacco People,' which was a well-known designation of a Huron tribe), Mr. Hewitt remarks, 'I am not aware that *garokwa* is used as a verb in any of the Iroquoian tongues.' If he will refer to the volume just mentioned, he will find, on p. 116 (paragraph 2), the word in question used as a verb in this native composition. The form here employed is *denighroghkwaïen*."

If *denighroghkwaïen* were an instance of the stem of *garokwa* used as a verb, it would prove Mr. Hale's position and the justness of his remarks; but, unfortunately for Mr. Hale, it is not such an instance. This will be shown in the sequel.

Moreover, Mr. Hale's contention that a mere superficial knowledge of the tongue is sufficient preparation to enable one to analyze accurately its terms and sentences is inconsistent and self-contradictory: since, if it be true that the Iroquoian tongue is "one of the most difficult of languages," then, before putting forth any etymologic analysis of its vocables and sentences, it is not only necessary, but imperative, to have a knowledge of its grammatic and morphologic processes sufficiently "profound" to enable the student attempting an etymology to ascertain the several parts of speech, their flexions, and their positions in sentence-words, because such a knowledge will prevent him from mistaking the

several parts of speech for real or fictitious flexions, and will prevent him from dividing sentence-words and derivative words in a capricious and erratic fashion, to give plausibility to etymologies and methods of verbal analysis based on a fatuous misconception of the structure of the language.

Moreover, the discriminating student, in pursuing his researches, will soon find that there is no published work on Iroquoian etymology and grammatic usage sufficiently elementary and accurate to be considered decisive authority in such matters; and whoever relies mainly or exclusively on published materials for his data and proofs should not be surprised to learn that his work is not scientific and not trustworthy, and that he labors without profit and without the attainment of truth.

Before beginning his analysis of *denighroghkwaien*, Mr. Hale changes its spelling to *tenirokwaienn*, in an attempt, as afterwards appears, to give validity to his fanciful derivation of it.

Mr. Hale puts forth this analysis in the following language: "*teni*, 'we two' (thou and I); *rokwa*, the 'theme' of the noun *garokwa* or *karokwa* ('pipe'); *i*, a vowel inserted for euphony; and *en* (or *enn*), the terminal inflection of the present imperative, in the second conjugation."

This alleged derivation is erroneous, and clearly at variance with all the structural and grammatic principles of the language.

For orthoepic reasons, the writer will employ, in the present analysis, the orthography *tenihrokuayēñ* instead of the spelling adopted by Mr. Hale.

The true etymology of *tenihrokuayēñ* is as follows: *te* (meaning "two") qualifies the noun-stem; *ni* (denoting "thou and I") is the pronominal prefix of the inclusive dual first person; *hrokua* (denoting "pipe," and "a portion of tobacco") is the noun-stem; *yēñ*, Mr. Hale's *ienn* (signifying "to place," "put," or "lay down"), is the verb-stem, being in the exhortative mode, which in this language has no mode-sign, notwithstanding Mr. Hale's unfounded assertion to the contrary. Hence etymologically this sentence-word means, "Let thee and me lay [our] two pipes down," and figuratively, "Let thee and me smoke." It is thus evident that *tenihrokuayēñ* (for *denighroghkwaien*) is not an instance of the noun-stem *hrokua* used as a verb.

Thus it is seen that Mr. Hale errs, first, in making the dual numerative *te* a part of the pronominal prefix; second, in virtually begging the question by miscalling the noun-stem *hrokua* a "theme," to give some plausibility to his erroneous assumption that it can have, as required, either a nominal or a verbal office, better to accord with his illusive treatment of it in his supposed etymology; third, by mistaking a common verb for an "inflection" unknown to the language, by his division of the well-known verb *ienn* (*yēñ* in the writer's lettering) into a vowel *i* for euphony, and his supposed mode-sign, *enn*.

In Iroquoian grammar the fact that a certain stem is combined with verb-stems to form compound or sentential words, is conclusive evidence that such a stem belongs to the class of generic or abstract nouns which cannot have a verbal function in addition to their nominal office.

A generic noun is one the stem of which may be compounded with verb-stems and adjective-stems, and one that cannot be a verb. When not in combination, i.e., when standing alone, its stem must have a prefixed pronominal gender-sign, and commonly a final vocalic sound which generally undergoes transmutation when the stem is compounded with other elements

In the "Iroquois Book of Rites" (p. 120, Section 9) appears the sentence-word *tetyathrokuanekeñ*. There it is faultily printed as written in the original manuscript, thus,—*theadetyatroghkwane-kenh*,—and its common but metaphoric meaning, "Let thee and me smoke together," is also given. The initial *tha* is evidently the misspelled contracted form *tho* of the locative adverb *e'tho* ("there"), which is not a proclitic, and should not therefore be treated as such. The etymologic elements of this sentential compound are the following: *te* (meaning "two") qualifies the noun-stem; *ty* (for *ni* by regressive assimilation) is the prefix pronoun of the inclusive first person dual, meaning "thou and I;" *at* (for *a't*, sometimes the sign of verbal reflection) has here rather a possessive force, denoting "our" or "our own," and qualifies the noun-stem; *hrokua* (meaning "pipe," "a portion of tobacco") is

the noun-stem; *nekeñ* (signifying "to set or place, together or side by side") is the verb-stem, being in the exhortative mode. Therefore the compound means literally, "Let thee and me place together our own two pipe[s]," and metaphorically, "Let thee and me smoke together."

The following examples confirmative of the abstract nominal character of the stem *hrokua* are cited from the "Radices Verborum Iroquæorum" of Father Bruyas, as published by Dr. Shea. These sentential compounds, although recorded for more than a hundred and seventy-five years, show that when they were recorded, *hrokua* was used strictly as the stem of a generic noun, and in exact accordance with the genius of the language. The forms in parenthesis are in the lettering of Father Bruyas; and the others, in the writer's orthography, are severally lettered to express their orthoepy. The first of these citations is *kahrokuēñta'o* for *kahrokuēñta'o* (*garokwentao*), i.e., "One has finished smoking," but literally, "One has ceased from [his] pipe or tobacco." Its etymology is as follows: *ka*, "one" (a person); *hroku-* for *hrokua*, "pipe" or "tobacco;" *ēñtá'*, "to stop," "end," "cease from," "finish;" and *o*, the sign of the perfect tense. This verb *ēñtá'* is erroneously classed under "Accidents Verbaux," with the title "Du Consomptif," by Father Cuoq in his "Judgement Erroné" (p. 65). It is, however, a verb, and not a flexion. The next is *ronathrokuayēñto* (*atrokwajenton*), i.e., "They severally have their own pipes or tobacco," but literally, "They severally have laid down their own pipe[s] or tobacco." Its analysis is as follows: *ron* (meaning "they") is the plural masculine third person of the prefix pronoun of the anthropic gender; *at* (usually the sign of verbal reflexion) is here the mark of possession, meaning "(their) own;" *hrokua* (denoting "pipe" or "tobacco") is the noun-stem; *yēñ* (signifying "to place" or "lay down") is the verb-stem, which in the perfect tense means "to have or possess;" *to* (denoting "severally" or "individually") is the distributive flexion; "' (an apostrophe) is here the sign of the perfect tense, and represents a suddenly interrupted guttural sound. This peculiar sound, although of the first importance and of essential and indispensable use in Iroquoian etymology and phonology, has, with a single exception apart from the present writer, been overlooked and disregarded by the students past and present of the language of the Iroquois. The Rev. Asher Wright, who, until his death in 1875, was a missionary among the Senecas in the State of New York, refers to this significant sound in his Senekan "Spelling-Book." While speaking of the phonology of the language, he says, "This letter (*h, H*) never precedes a vowel; following one, it should be spoken by giving the vowel an explosive force, and breaking it off suddenly, in such a manner as for the instant to stop the breath entirely. . . . This sound is very abundant in Seneca, and, used in conjunction with certain other modifications, the mode and tense of verbs, and various other circumstances, are denoted by it. Often, also, it forms the chief distinction between words of very dissimilar meaning. No one can read or write Seneca intelligibly who does not pay the strictest attention to this character." . . . These important remarks are equally pertinent to all the other dialects of the Iroquoian tongue, including the Tserokian dialects.

The third citation is *ronathrokuakhaho* (*atrokwaghahon*), i.e., "They severally are apart smoking," but literally, "They severally have their pipes apart." The pronominal and the nominal parts being the same as those explained in the last example, it will be needful here to speak only of the verb and its flexions. The verb-stem is *kha*, and means "to separate," "divide," or "have apart;" *ho* is here the distributive flexion, meaning "severally," "individually;" "' , previously explained, is the sign of the perfect tense. The last citation from Bruyas is *twathrokuanekeñ* (*twathrokuaneken*), i.e., "Let you [plural] and me smoke together," and literally, "Let you [plural] and me place our own pipes together." The following is the analysis of this compound: *tw-* (signifying "ye and I") is the inclusive plural first person of the prefix pronoun; *at* (commonly the sign of verbal reflexion) means here "our," "our own;" *hrokua* is the noun-stem, denoting "pipe" and "a portion of tobacco;" *nekeñ* (meaning "to set or place together or side by side") is the verb, being in the ex-

¹ These letters should have an oblique line through them.

hortative mode, which, as has been said, possesses no distinctive mode-sign.

These several examples of the compounding of the stem *hrokua* with different verbs furnish conclusive evidence that it is a noun-stem, and that it is never used as a verb: hence it cannot, of course, have an "indeterminate verbal" form *yehrokua*, although Mr. Hale has been misled to believe it can have.

In the writer's article first above mentioned the conjectured "indeterminate verbal" form *yehrokua* (Mr. Hale's *ierokua*) was rendered "one smokes by which" by the writer, instead of the words "they who smoke," suggested by Mr. Hale.

Evidently overlooking the reasons for the correction, he says, "The indeterminate form, however, is constantly used with a plural signification." The writer's correction, however, was intended primarily to show that if *yehrokua* were a verb, ending as it does in *kua*, which with verbs is the instrumental sign, it would have an instrumental or causative meaning in addition to its assumed predicative meaning, "one smokes;" second, to emphasize the important fact that *ye*, its pronominal prefix, has not a relative meaning, expressed by "who" in Mr. Hale's rendering, for it is certain that in this language there is no pronominal prefix which has in itself both a nominative and a relative meaning, and also to show the writer's preference for rendering a singular pronoun by an equivalent of a like number. Furthermore, the correction was intended to bring to view the all-important fact that since a sentence-word in the instrumental or causative mode predicates the means or instrument of an action or a state or condition of being, it may become the descriptive name of that means or instrument, and, lastly, it may become a generic noun through further development; and that it may not become a name of the same thing or things of which its nominative prefix pronoun is also a name, as implied in Mr. Hale's faulty translation and unfounded etymology of this conjectured verbal form. These are among the chief reasons why the writer objected to the derivation of the word "Iroquois" from the supposed verbal form *yehrokua*.

Only a misconception of the grammatic and morphologic structure of the Iroquoian tongue could be the basis of the errors and linguistic fallacies to which Mr. Hale has given utterance in the following language. He says, "The manner in which Iroquois verbs are formed from nouns, and in turn yield nouns expressive of agency or condition, will be apparent in the inflections of the word *kanonsionni*, the well-known name of the Iroquois confederacy. It means literally 'the extended house,' from *kanonsa* ('house') and *ionni* ('to extend' or 'lengthen out'). Replacing the noun-forming prefix *ka* by the verb-forming prefixes, we have, in the third person, singular and plural, *ranonsionni* and *rotinonsionni*, literally 'he [who] extends the house,' and 'they [who] extend the house,' but understood to mean 'he is an Iroquois,' 'they are Iroquois,' or, as nouns, simply 'an Iroquois,' 'the [plural] Iroquois.'" This is a series of erroneous statements.

Now, a "noun-forming prefix" and "verb-forming prefixes" are unknown to this language. Mr. Hale's ascription of such a novel office to the prefix pronouns of this language is therefore pure fancy.

The very prefix *ka*, which he calls a "noun-forming prefix," has no such function, as it is a prefix pronoun; and the sole office performed by the prefix pronouns of this language is to express, more or less clearly, person, number, case, and, in third persons, gender and generally sex.

The pronoun *ka* cited above is used indifferently with verb-stems, adjective-stems, or with noun-stems; and yet it does not transform the verb-stems and the adjective-stems into noun stems, which it would most assuredly do had it a "noun-forming" function. It is a pronominal affix to the following and other verbs, — *kanonhwe's*, "it loves, cherishes, [it];" *kahnino's*, "it buys [it];" *kahraraks*, "it bores [it];" *kakē*, "it sees [it];" *karyūs*, "it kills [it];" *kariks*, "it bites [it];" — and yet these verb-stems do not become noun-stems. This fact is conclusive evidence that the prefix pronoun *ka* has not a "noun-forming" office.

Moreover, as Mr. Hale substitutes the masculine prefix pronouns *ra* and *roti* (the latter erroneously for *rati*) for the prefix *ka*, they

must be, therefore, two of the "verb-forming prefixes" mentioned by him. But with what has been said concerning the prefix pronoun *ka*, and the general purpose of the pronouns, it is only needful to add here that the pronouns *ra*, *rati*, and *roti*, mentioned above, are used indifferently with noun-stems, adjective-stems, and verb-stems; and yet the nominal and the adjective-stems do not become verb-stems, as they would if the prefixes *ra*, *rati*, and *roti* possessed "verb-forming" powers. The following examples confirm what has just been said, — *roti'niko,ra*, "their [masculine] mind;" *raorihwa*, "his matter, business;" *rotirihwa*, "their [masculine] matter, business;" and the following with adjectives, — *rahoñ'tei*, "he [is] black;" *ratihoñ'tei*, "they [are] black;" *ranaye*, "he [is] proud;" *ratinaye*, "they [masculine] are proud;" *rakowanēñ*, "he [is] large;" *raticowanēñ*, "they [are] large."

These facts make it clear that Mr. Hale is wholly mistaken as to the nature and office of the prefix pronouns in this language.

Again, judging by his translations, it is evident that he employs the letters *ionni* to express two very distinct forms of the verb-stem *yoññi*, — the present of the indicative, and the perfect tense participle, — a distinction of which he appears to be unaware. The stem of the present may be accurately lettered thus, *yoññi*; and that of the participial form thus, *yoññi'*. In both, the final vowel *i* is short, but in the latter case followed by the peculiar and important sound represented by "' (an apostrophe).

Mr. Hale's rendering of his *ranonsionni* and *rotinonsionni* by "he [who] extends the house" and "they [who] extend the house," respectively, shows that he was unaware of the fact that the two prefixed pronouns were peculiar to different tenses, and that consequently they could not be rendered in the same tense, else he would have indicated this fact in his orthography and translations of the two forms cited; and his interpolation of the relative "who" in these translations is gratuitous and fanciful, for reasons already stated elsewhere in this article.

In Mr. Hale's orthography, the letters *nonsionni* express the compound stem of the sentence-word *kanonsionni*. The writer will represent this stem with the following letters diacritically marked; thus, *no^syoññi* for the present of the indicative, and *no^syoññi'* for the perfect tense participle of the same mode.

The forms *rano^syoññi* and *ratino^syoññi* may be respectively rendered, "he extends, is extending, the house," and "they [masculine] extend, are extending, the house;" but *rono^syoññi* and *rotino^syoññi*, by "it or he extends, is extending, his house," and "it extends, is extending, their [masculine] house." These forms are in the present indicative, but the change of signification wrought by the change of the forms of the prefixed pronouns is noteworthy. The forms *rano^syoññi'* and *ratino^syoññi'* may be respectively rendered "he-house-extended-[is]" and "they [masculine]-house-extended-[are]," and freely, "he is, they are, an extended-house;" *rono^syoññi'* and *rotino^syoññi'*, by "his-house-extended-[is]" and "their [masculine]-house extended-[is]," i. e., "his, their, house is extended." The last four sentential forms are participial, the substantive verb being commonly understood in the present tense of the discourse.

The participial sentential forms are expressive of a state or condition of being, and for this reason only can they convey the "idea" of "a man of the extended-house." For this reason it is imperative to distinguish carefully between these and the verbal sentential forms of the present of the indicative.

In addition to the foregoing corrections of Mr. Hale's errors as to the first principles of the language, it is necessary to add that the participial forms may be translated correctly only by the sentences "He is an Iroquois" and "They [masculine] are Iroquois," and not by the titular and cognominal words "an Iroquois" or "the Iroquois." Sentences are translated with complete and formal accuracy only by sentences. Each of the mooted verbal combinations forms a sentence, — a combination of parts of speech making together complete sense.

Mr. Hale's assertion, as explained by himself, that "the manner in which Iroquois verbs are formed from nouns, and in turn yield nouns expressive of agency or condition, will be apparent in the inflections of the word *kanonsionni*," is therefore at variance with the structural laws of the language.

Such faulty and inaccurate work must necessarily shake the confidence of scholars in the trustworthiness of the results of linguistic methods and theories such as those herein criticised.

To allow etymologies and methods of linguistic research such as those just criticised to pass unchallenged, and to leave them without pointing out the misconceptions upon which they are based and the fanciful reasonings wrought in their support, would be tantamount to accepting error and fancy for truth. Although it is proper to deprecate "wasting our time in minute verbal criticism of the work of our fellow-students," yet it is difficult to avoid seeing that it is imperative on scholars, in every department of science, to test the work of their fellow-investigators by rigid and discriminating analysis; and, if they fail to perform this their most evident duty, the student unfamiliar with the subject-matter will be left to assume that faulty and inaccurate work rests on a foundation of fact, and will be more than likely, especially in the beginning of his career, to make it the basis of further research, and, of course, new error.

In conclusion, it should be borne in mind that those who will not, personally and without preconceptions, study this language, and who appear to be unable to see any thing on which the light of their theories does not fall, and who do not "profess to distinguish the niceties of Indian pronunciation," although these so-called nice distinctions are, in fact, the marks and indices of essential grammatic and morphologic elements, must not hope to accomplish, in the domain of Iroquoian etymology and morphology, trustworthy and accurate work.

J. N. B. HEWITT.

Washington, D. C., Jan. 28.

A Double Motion of Clouds.

It is generally accepted that our storms and high areas drift in the upper currents of the atmosphere, and that the direction of motion of clouds will give us important information as to the direction of the former. The present writer has devoted most careful attention to this subject for more than three years and a half, and has found that while clouds, especially the higher forms, have a general tendency to move in the same direction as storms, that is, from west to east, yet they are a very poor guide to follow in special instances, and they fail especially at times when such assistance is the most needed. This may be in part due to the fact that the upper clouds cannot be seen in the neighborhood of storms, and in part to the difficulty of estimating the height of clouds. In the case of high areas, the clouds frequently are less than three-tenths, and, if so, their direction does not appear on the maps. Much time has been spent in watching the motion of clouds at all hours of the day, and it is possible that a very important factor in their motion has been omitted.

Every one has remarked the beautiful cirrus stripes which are often seen traversing the sky, usually from south-west to north-east. I have gleaned the following statements from various authorities. Van Bibberspeaks of them as resembling trees on the streets. This probably refers to the narrowing effect due to perspective. He also says, "These formations were given by Humboldt the ill-suited name 'polar bands.'" Kaemtz says, "In Germany these clouds are known under the name of 'wind-trees' (*Windsbaum*)."

In a footnote Martius says, "The tendency which the cirri have to arrange themselves in parallel bands is remarkable; and it proves that the cause which directs their filaments to one azimuth rather than another, instead of being merely local and accidental, extends to great distances. By a well-known law of perspective, parallel bands ought to appear diverging from one point of the horizon, and converging at the point of the horizon diametrically opposite. The phenomenon occurs more frequently in Lapland than in the temperate zone. Humboldt found that at the equator the bands were generally directed from north to south. The cause, which thus arranges the great axes of these clouds according to parallel lines, is still unknown. Forster was the first who made the very just remark that these clouds almost always travel along a parallel to their great axis, which greatly contributes to render them apparently motionless. Many meteorologists (Howard, Forster, Peltier) seem to believe that the cirri serve as conductors between two distant foci of

electricity, of opposite names, which tend to combine, and that the flexibility of the conducting clouds terminates in the rectangular form, which is necessitated by the condition of the shortest path from one focus to the other." Loomis says, "The direction of the parallel bands generally coincides with that of the wind, and it has been suspected that these lines of cloud serve as conductors of currents of electricity, and this may be the agent which causes the clouds to assume such artificial forms." A more guarded statement than this it would be difficult to put forth.

Abercromby of England has probably given more attention to these motions than any one else. He speaks of the appearance as being known as "Noah's Ark" in England. "Frequently we see the curious spectacle of a long stripe of cloud moving either broadside on or obliquely to its length. As we must suppose that a stripe always sails with the wind in which it floats, we have to find out how a stripe can be formed which moves across its length. At first sight, this is one of the most puzzling phases of cloud-motion. These formations of clouds are, however, exactly analogous to the smoke left by a steamer running before the wind. If she runs faster than the wind, her smoke trails behind; but if the wind blows faster than she steams, then the smoke is blown forwards in front of her." He then shows that if the direction of the steamer is not that of the wind, the line of smoke will form an angle with the former. "Now, this is exactly what happens in nature. The ascensional column of moist air, which will eventually form a cumulus, starts from near the earth's surface, drifting with the wind which blows there; when it arrives at a certain height, it meets an upper current moving in a different direction to that on the surface, and probably begins to condense there. The stripe which would be formed under these circumstances would behave exactly like the smoke of a steamer; that is to say, it would lie obliquely to the wind which was driving it." Any one who is desirous of learning more of these views and observations will find them in "Weather," pp. 84-91.

I have made these quotations very freely from all the authorities I have at hand, fourteen in all, as it seems to me the subject is of the highest importance, and has been very much neglected up to the present. My own observations are as follows. In a perfectly clear sky these clouds will come up from the south-west, and move gradually to the north-east. When the stripes are overhead, a double motion is often very easily recognized. One of these may be quite rapid, and I have often noticed that it coincided with the north-west wind or at right angles to the stripe. From observations on Mount Washington and of cirrus in Europe, this velocity may be a hundred or even a hundred and fifty miles per hour. At the same time, it is not a difficult matter to recognize a second motion directly in the line of the stripe. This motion may be a third or a fourth that of the other, and sometimes it is very much slower. Observation indicates that this second motion is often, if not always, in the direction of the storm which is then near the station. If this can be incontestably established, it will be seen what an extraordinary advance will be made in our studies. We shall see, then, that this marked movement of the upper current which first attracts our attention, and so often masks the second motion, is, after all, the less important as relates to the movement of the storm. The greatest interest centres about the cause of this second motion. It is evident that these stripes do not form conductors of electricity, because their motion occurs in lines where there are no clouds. Is it not probable that this current exists in the first place? During the last maximum of sunspots, I observed very carefully an electric light playing in cirrus stripes in my zenith, and mentioned the fact to others. I have also observed a motion in auroral beams which was not so very different from this second motion of cirrus stripes. The suggestion made by Mr. Abercromby, that this second motion takes its origin in a lower cloud, which keeps its direction after rising to a higher level, cannot be accepted at all. Such a motion as that would be very quickly brought to rest instead of being in existence for a hundred miles or more. Moreover, the origin of these beautiful and regular cirri cannot possibly be in irregular masses of cumulus rising heterogeneously from a lower to a higher level.

It seems to me that there are needed just now a careful series