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toren, und werden sie in verändertem Zustand auf die Nachkommenschaft übertragen; 2. die Ursachenfrage „Welche Ursachenzusammenhänge lassen sich für die Veränderung von Erbfaktoren nachweisen?"; 3. die Zweckfrage „Sind die erworbenen bzw. veränderten Erbfaktoren „zweckmäßig" dem betreffenden Organismus „zweckdienlich" nützlich?" und 4. die Ursachen- und Anpassungsfrage nach der „Existenz eines richtenden Faktors". Im dritten Hauptteil zieht er dann die Schlußfolgerungen für das praktische Handeln im Bereich des Menschlichen. Welcher Art diese Schlußfolgerungen sind, die sich aus den Antworten auf die vier Hauptfragen ergeben, möge ein jeder selbst in ZIMMERMANN's Werk nachlesen, das sich für die Zukunft als unentbehrliches Handbuch des behandelten Fragengebietes erweisen wird. TH. HALTENORTH (Berlin).

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## 2.) Remarks on Arthur H. Howell's Revision[1]) of the North American Ground Squirrels.

By E. RAYMOND HALL[2]) (Berkeley).

In this taxonomic paper based on a study of 11840 specimens 97 kinds (species and subspecies) of ground squirrels are recognized, all of the genus *Citellus*. These pertain to 31 full species of 8 subgenera. Of these, the subgeneric names *Poliocitellus* (type *Arctomys franklinii* SABINE) and *Notocitellus* (type *Spermophilus annulatus* AUDUBON and BACHMANN), and the names *Citellus washingtoni washingtoni* [= *Citellus townsendi* of recent authors], *Citellus washingtoni loringi*, and *Citellus beecheyi sierrae* are for the first time proposed. However, one other full species and 10 other subspecies were named by the author in preliminary papers resulting from the present study.

For the 97 kinds, 128 names have been proposed, giving an average of 1.32 names per kind. Of the 97 „valid" names 32, or practically a third, were proposed by C. HART MERRIAM who contributed 9 of the 31 names regarded as synoyms; his score of 78 % is 3 % better than that of 75 % attained by all others who have proposed names for American ground squirrels.

A special feature of the present work is the inclusion of 11 colored plates of ground squirrels. „They look to be old", was the remark, or sense of the remark, of each of five mammalogists to whom I showed my copy — an observation whose aptness is verified on page 2 of the paper. There we learn that the plates were made [printed] about 40 years ago. For these, the artist, ERNEST THOMPSON SETON, who then signed himself Ernest E. Thompson, has but little if anything to apologize. Plate number 10, of the antelope ground squirrels, is particularly good. Nineteen plates well show the outlines of the skulls of the several genera of Sciuridae and many forms of the genus *Citellus*. The corresponding bacula of many of these are shown on plate no. 13 and the enlarged dentition of *Cynomys*, plate no. 12, illustrates the nomenclature employed by HOWELL for she cusps.

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[1]) HOWELL, ARTHUR H. — Revision of the North American Ground Squirrels with a classification of the North American Sciuridae. — North Amer. Fauna **56**, pg. 1—256, pls. 1—32 (11 colored), 20 ffgs. in text, April [May 18], 1938. (40 cents at Supt. Publ. Documents, Washington, D. C.)

[2]) Read at the „Vertebrate Review", Museum of Vertebrate Zoology, Berkeley, California, September 6, 1938.

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Typographical mistakes are few. A correction slip directs attention to 5 relatively unimportant errors. The only other misspellings noted are Moffat on page 10, Uintah page 117 and Millette page 172. In the footnote to page 175, 50b may be a misprint for 80b. In line 3 of page 181, *cinnamomeus* appears in place of *pennipes*. For *washingtoni*, *ablusus* and *canescens* the total numbers given for „specimens examined" do not agree with the acutal listings; a misplaced parenthesis may explain a seeming inconsistency of this same kind for *lateralis*. The account of molt for *C. b. beecheyi* is based on specimens elsewhere in the paper identified as *C. b. fisheri*. One animal from Oposura, Sonora, listed among the specimens examined of *C. v. rupestris*, is identified as *C. v. grammurus* in the text (pg. 144) and on the distribution map. For *C. r. elegans* the distribution map indicates a range much farther south in Idaho than any place from which specimens are recorded as examined. Of *O. armatus* specimens are listed from Arco, Idaho, but the distribution map fails to include this locality. *C. c. columbianus* is said to range as far south as Craters of the Moon, Idaho, but the distribution map does not show this, and no specimens are listed under that locality name. These inconsistencies, relating to Idaho, I think, are due to the author's efforts to include at a late stage in the preparation of the paper, information in a manuscript prepared by, and sent to him by, W. B. DAVIS on the *Citellus* of Idaho. However, *C. l. chrysodeirus* is listed from Nevada and *C. t. wortmani* from Utah, although the distribution map (fig. 20) fails to show their occurrence in these states or the occurrence of *C. l. trepidus* anywhere in west central Nevada, although specimens of it are recorded in the text from two places in Douglas County which lies in the western part of that state. Also the mapped range of *C. v. grammurus* is not extended far enough westward in Sonora to include Hermosillo, a place from which three specimens are mentioned. The lack of a precise date of publication reflects no credit on the standards of the Government printing office; the correction slip gives May 18, 1938, as the date.

Measurements are in running text under the account of each form and are not collected in a table as would permit a user of the paper to compare several forms readily, or to compare measurements of a specimen in hand with those recorded by Howell. This system of separate recording of measurements involves 97 repetitions of the name of each measurement and therefore probably saves nothing in cost of printing as compared with a more compact tabular arrangement of the same material. In the end, if used at all, the reader must, in 4 times out of 5, copy out the measurements of the several races in tabular form.

In the lists of „Specimens examined" locality nomen are arranged alphabetically by the initial letter of what the author selected as the first word of a locality designation. Some workers would select other words for the initial parts of these locality names and thus arrive at a different order of arrangement which would make for difficulty in finding a name. On this account and for other reasons I think the lists would be more useful if the place names for each state, and province in Canada, had been arranged on some geographic basis, say, by counties from north to south.

A more serious matter is the general and incomplete designation of many localities of capture which the collectors took pains to record on the specimen labels exactly enough to meet the standards set for modern types of studies of geographic variation and distribution. For example, specimens of *Citellus leucurus leucurus* from Nevada recorded as from „Spring Valley (White Pine County)" really are labeled „7 mi. SW Osceola, 6275 ft., White Pine Co., Nev." The mentioned valley extends 70 miles across the country. Again, „Quinn Canyon Mountains", a range 60 miles long in two counties, refers to material labeled „Big Creek, 5700 ft., Quinn Canyon Mts., Nye Co., Nev." Obviously with localities of capture of animals recorded in terms as general as those just mentioned, specimens may be listed as taken at places where the species does not occur and certainly a user

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of the monograph who attempts to plot the localities on a map of his own is unable to place many of them at all, and will plot others incorrectly.

In distinguishing species and subspecies, HOWELL seems to place more reliance on coloration than on cranial features. External proportions seem to be relied upon to an intermediate degree. The late HARRY S. SWARTH, and J. A. ALLEN in his earlier work, did the same thing and I wonder if the common interests, birds, shared by all three may not offer a clue to the reason therefore. In studying species and races of birds, major attention is given to color of plumage rather than to the skull which is less often, and I think less profitably compared than in mammals. Possibly habits of work acquired white identifying birds discourage, first, the close visual comparison of shape, and, second, the tedious instrumental calibration often required to make out differential features between the skulls of subspecies and closely related species of mammals. However, in the Sciuridae cranial differentiation of minor systematic units is relatively difficult; the smoothly rounded skull of *Citellus lateralis*, for example, presents far fewer opportunities for observing variations than the abundantly ridged and sharply angled skull of, say, *Thomomys bottae*. Nevertheless, constant differences in shape of skulls do exist between several kinds of ground squirrels which in the present paper are described cranially only as „closely similar" or as „slightly smaller".

HOWELL's particular fashion of comparative description of the skull often leads the reader, intent on learning what the skull of a given form is like, around to the starting point; that is to say, he may by following through several accounts of cranial characters, from one to the next used in comparison, find the author to have said in effect that the skull of *C. l. lateralis* is like the skull of *C. l. lateralis!* A description as complete as required of one race, and comparison of each geographically adjoining race with this initial description is one method for avoiding the pitfall into which HOWELL's accounts of „cranial characters" leads him and those who attempt to employ several of his accounts.

Near the beginning of the paper the reader finds much about the economic importance to man of the animals concerned; a circumstance that is readily understood when one recalls how great a share of the resources of the Bureau of Biological Survey, the sponsoring agency, is devoted to the „economic" aspect of biology. In this instance the economic importance is emphasized by presenting almost entirely the debit side of the ledger of the animals' activities; damage to crops, promotion of soil erosion, and transmission of diseases to man are stressed. The credit side of the ledger is largely ignored; nothing is said at all of the squirrels' services as a food source for fur bearers, or of their promotion of soil fertility and water conservation, and there is only one mention (pg. 20) of the checking effects that the animals exert on other organisms. The misleading nature and biologically faulty character of these initial pages may be ascribed to the author's habituated acquiescence in a bureaucratic tradition. With this exception the brief life history accounts may answer the purpose for which written, namely, an introduction to the systematic accounts. Also they have merit in themselves as summarizing much of the available information on certain phases of life history.

An extremely valuable feature of the paper is the classification of the genera and subgenera of North American Sciuridae on the basis of osteological characters. The diagnoses seem complete for the information previously available and it appears to have been carefully sorted and wisely combined. This careful summation alone would earn for the author the respect of other mammalogists but he has done much more than critically compile and evaluate; he has described previously overlooked features of the skull and dentition and more especially has included the findings resulting from his original study of the baculum. This new information it appears has aided in making out the relationships of the superspecific groups, but HOWELL is judicious in its use and thinks „that in the ab-

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sence of trenchant cranial characters, the morphology of the baculum alone should [not] be considered [as] of generic value."

Turning to the systematic accounts we find common names provided for each subspecies — a feature that will be approved by many biologists, but by others regarded as less useful than a name distinctive of the full species, and applied to all of its subspecies alike. The synonomies aim for completeness as regards different names and name-combinations employed for each form rather than for completeness as to all published accounts. In this connection the full bibliography at the end of the paper, which will be useful to many students, has the citations generally in the form recommanded by SHIELDS (Science, for July 1, 1938, pg. 1). This form places the name of the institution before that of the series and it is to be hoped that other mammalogists will follow the lead given here. Artificial keys to subgenera, species and subspecies facilitate identification of specimens.

The body of a typical species account is arranged under the following paragraph headings: type, range, external characters, cranial characters, color, measurements, remarks, and specimens examined. Sometimes weights of the animal and manner of its molt are added. With reservations as already noted for sections on measurements, cranial characters and specimens examined, the accounts are adequate. Although in many places HOWELL might have written more, the essentials are there and other systematists would do well to study his presentation and follow his example. Because the accounts are concise and uniform they are easy to use. The 20 distribution maps show the range of every one of the 97 forms and are placed appropriately for most ready reference. The one exception I found was that of *C. atricapillus* which for cartographical convenience is included with the map for *C. grammurus* rather than along with that of its nearer relative *C. beecheyi*.

With reference to nomenclatural handling and systematic treatment of the several forms, it is noteworthy that *atricapillus* is given specific rank. It is said, by those who know its habitat, probably to owe its differential features to the effect of the dark lava substrate where it lives. It differs from other races of *C. beecheyi* in about the same way that *C. v. tularosae*, also a lava bed race, differs from other races of *C. variegatus*, and *tularosae* is given only subspecific distinction. Of course HOWELL may be correct in his treatment of *atricapillus* as I think he is in raising *C. brunnaeus* to full specific status rather than leaving it as a subspecies of *C. washingtoni*. On this score the 31 full species, of the single genus *Citellus*, recognized by HOWELL is a notable reduction from the 55 species of 4 genera that stood in our scattered literature before his paper appeared. The reduction of the several „species" to subspecies appears in all instances justified if we accept, as I think we should, the criterion of intergradation as the test of a subspecies (= geographic race).

On this matter of subspecific identification the present paper contrasts strongly with earlier systematic papers by the same author. In these he often ascribed two subspecies to the same area. Apparently, from a study of a few selected series of specimens he decided on differential characters for two adjoining races and then allocated each additional specimen according to its individual characters. The result sometimes was the recording of a single specimen of subspecies A from well within the geographic range of subspecies B. (In illustration, see *Spilogale phenax phenax* and *S. p. latifrons* from Marin County, Calif., N. A. Fauna 26. 1906). No logical objection can be taken to this practice, it seems to me, providing a person elects to subspecifically identify each specimen individually on the basis of its morphology. However, the modern practice of recognizing „individual variation" and relying upon the mode, mean, or norm, of a population from one place as a basis for subspecific identification of the animals there, results in an arrangement more useful to the average student of geographic variation. The revision of the ground squirrels

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is strictly in accord with modern practice. HOWELL's ability, relatively late in life, to revise his concept of a subspecies illustrates his right to membership in the fraternity of scientists and challenges his junior colleagues to retain an equal degree of open-mindedness.

Changes of name to which we least quickly may become accustomed include abundonment of *Callospermophilus* and *Ammospermophilus* as generic names in favor of *Citellus*; the species name *townsendii* is transferred to one of the races of the species called *Citellus mollis*, so that we have the combination *Citellus townsendii mollis;* the new name *C. washingtoni* is proposed for the animals formerly called *C. townsendii.* To have authoritative precedent for arranging *C. chouchii* and *C. buckleyi* as subspecies of a single species along with *C. grammurus* is appreciated, and the same sort of satisfaction is felt when dealing with the racial names applied to the big Arctic ground squirrels, now arranged under the specific name *Citellus parryii.* The relegation to synonymy of the names *stephensi*, *leucodon*, *washoensis* and *pessimus* in the *townsendii* group I confess makes easier the identification of specimens but is a more conservative treatment of geographic variants than I suspect will obtain in the future.

Even though this suspicion proves to be well founded the most that could be made of a difference of opinion about employing these names would be a charge of conservatism against HOWELL, and most vertebrate zoologists, I think, rightly prefer conservatism in a revisionary paper. Thereby its value, immediately and also as a foundation for future studies, is enhanced. That this paper will be employed abundantly in both ways is assured by the great number of persons interested in ground squirrels.

My personal estimate of the paper is that by and large it is a good one, probably the best of the 8 revisions of mammalian groups published by HOWELL, and that for it he deserves the congratulations of all mammalogists. To stimulate discussion, and because of my personal conviction as to the paper's worth, I now offer (save for restricted portions, above noted) for the remainder of our review hour to defend it and its author against all query and any criticism.

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