

SMITHSONIAN
MISCELLANEOUS COLLECTIONS

VOL. 110



"EVERY MAN IS A VALUABLE MEMBER OF SOCIETY WHO, BY HIS OBSERVATIONS, RESEARCHES,
AND EXPERIMENTS, PROCURES KNOWLEDGE FOR MEN"—SMITHSON

(PUBLICATION 3984)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
1949

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

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A. WETMORE,

Secretary of the Smithsonian Institution.

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SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 110, NUMBER 1

Roebling Fund

SOLAR VARIATION ATTENDING WEST INDIAN HURRICANES

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(PUBLICATION 3916)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
APRIL 20, 1948

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

Koebling Fund

SOLAR VARIATION ATTENDING WEST
INDIAN HURRICANES

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West Indian hurricanes rarely occur except in the months June to November. Table 1 shows the monthly distribution of 69 major hurricanes from 1923 to 1946. It seems probable that in these months, especially in August, September, and October, there is such an unstable meteorological condition in those regions that only a slight impulse suffices to precipitate the cataclysm.

TABLE 1.—*Distribution of West Indian hurricanes, 1923-1946*

Month	June	July	August	September	October	November
Number	3	5	19	25	14	3

Many years ago the late Herbert Janvrin Browne came to me with a dozen dates of first reports of West Indian hurricanes. He pointed out that on these dates Smithsonian solar-constant values had been depressed. I was so sensible of the accidental errors of individual solar-constant results that I was inclined to regard his observation as merely a coincidence. However, I prepared a table of sequences of solar-constant values from 10 days before to 10 days after his dates. The mean value of the 21 columns did indeed show a slight depression at the date of first report, but so slight that I was disinclined to attribute any significance to it.

Since then the solar-constant values from 1923 to 1946 have all been carefully gone over and revised to final form. They are now, of course, several times as numerous as they were then. It has occurred to me to re-examine this question with the advantage of better and more extensive data.

With the kind advice of the United States Weather Bureau, I collected 69 dates, partly from the December numbers of Monthly Weather Review, partly from Tannehill's "Hurricanes," when major West Indian hurricanes occurred in the years 1923 to 1946. Six of these dates were omitted because of almost complete lack of solar-

constant data, or because of very closely overlapping sequences. Corresponding to each of the remaining 63 dates I wrote out the values of the solar-constant as observed at Montezuma, Chile, from 10 days before to 12 days after the dates when the hurricanes were first reported. On 17 of these remaining dates the 21-day sequences of solar-constant values, especially in the neighborhood of the hurricane dates, were so fragmentary that I disregarded them. This left 46 dates to be considered with more or less complete solar-constant sequences closely adjacent to the hurricane dates.

I should remark that I used the solar-constant values as observed, not those marked "preferred" in table 24, volume 6, *Annals of the Astrophysical Observatory of the Smithsonian Institution*. I also disregarded all marks of "grade." I have become convinced by several researches that the procedure used to obtain "preferred values" is undesirable, and that the "grades" of volume 6 were sometimes assigned with prejudice against wild values which after all may have been good. The daily solar-constant values from 1939 to 1946 are as yet unpublished but were made available to me. Mr. Aldrich informs me that when assigning "grades" to them he and his colleagues were very careful not to be influenced by the wildness of a value. Hence I felt justified in rejecting a very few discordant values of low grades in this later work. I may add that I rejected the solar-constant values of September 9, 10, and 12, 1930, which fall far out of line, because they preceded a spell of bad weather from September 11 to 24 when only 2 days of observation at Montezuma occurred in that whole interval, and these also gave values abnormally low. I also rejected the solar-constant value of September 25, 1923, because it is very abnormally high.

Table 2 gives the dates of hurricanes, including the entire 69, of which the 17 rejected for fragmentary sequences of solar-constant values are starred, and the 6 omitted as stated above have daggers.

Table 3 gives the values of solar constants for the 46 remaining hurricanes from 10 days before to 12 days after the date of first report. The number of solar-constant values included in each of the means is given just above the means themselves. The mean values are plotted in figure 1. As given in table 3 they should be understood as prefixed by 1.9 calories.

There appears a gradual descent of the solar constant prior to the date of reports, amounting to 0.0016 calorie. Then comes a sudden drop of 0.0031 calorie to a sharp minimum on the actual day of first reports. After that the solar constant recovers on the third day, but not quite to its former level.

Although the depressive effect is very clear in the mean values, not all the sequences of solar-constant values show a depression on the day of first report of a hurricane. In fact, of the 46 cases used to form the means, there are 14 in which on the day of first report of the hurricane the solar constant was observed as high, and in a few cases even slightly higher than on the days preceding and following. I doubt if this discrepancy should be attributed to accidental error. Hence we

TABLE 2.—*Dates of first report of major West Indian hurricanes, 1923 to 1946*

1923:	Sept. 24.
1924:	Aug. 16, 27; Sept. 14.
1925:	Nov. 29*.
1926:	July 22; Aug. 21 †; Sept. 6; Oct. 14.
1928:	Sept. 6 †.
1929:	Sept. 22.
1930:	Aug. 31.
1931:	Sept. 6*, 9 †.
1932:	Aug. 11, 30*; Sept. 26*; Oct. 31*.
1933:	June 27; July 25*: Aug. 17*, 28 †, 31 †; Sept. 10, 16; Oct. 1, 26.
1934:	June 4; Sept. 5; Oct. 1; Nov. 21.
1935:	Aug. 31*; Sept. 23 †; Oct. 19, 30*.
1936:	July 27; Aug. 28*; Sept. 8, 24.
1937:	Sept. 14, 20.
1938:	Aug. 14, 23; Sept. 16.
1939:	Oct. 12, 29.
1940:	Aug. 5, 30; Sept. 11.
1941:	Sept. 18, 23*; Oct. 3.
1942:	Aug. 21; Nov. 5.
1943:	July 26; Aug. 30; Sept. 11; Oct. 11*.
1944:	July 30; Aug. 16; Sept. 8*, 19*; Oct. 13*.
1945:	June 20; Aug. 24; Sept. 11*; Oct. 2*.
1946:	Sept. 12; Oct. 6*.

* Rejected because of fragmentary sequences of solar-constant values.

† Omitted because of almost complete lack of solar-constant data.

are not to infer that a depression of the solar constant is always necessary to bring on a hurricane. Nevertheless frequently it appears to be the impulse which starts the cataclysm.

Lest some critic should suspect that the 17 dates rejected for fragmentary solar-constant sequences might have been unfairly rejected, and, if included, would lead to a different conclusion, I have thought well to take the mean values for all of the 17 rejected sequences, fragmentary though they are. The means are given in table 4 with the numbers of values entering into each mean. The means of these values are very divergent, partly because the observations are few, but more because parts of these sequences lie at different levels of

TABLE 3.—*Montezuma solar-constant values from 10 days before till 12 days after first reported dates of West Indian hurricanes*

Dates of first report	Days before and after first reported dates																							
	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	
1923, 9, 24	56	62	57	32	45	60	54	53	58	49	47	70	51	52	52	49	46	43	40	50	40	50	40	
1924, 8, 16	61	64	60	45	41	39	..	38	44	45	45	45	41	32	..	..	..	..	32	38	44	37	44
" 8, 27	45	41	32	..	..	..	..	32	38	44	37	44	..	..	..	41	40	..	..	53	43	43	54
" 9, 14	..	..	53	43	54	..	..	..	40	51	47	50	..	46	..	55	49	44	45	..	..	..	54
1926, 7, 22	50	44	..	42	52	43	44	..	40	54	37	44	..	48	44	40	51	43	47	41	45	43	47	
" 9, 6	56	44	57	..	37	37	47	40	39	47	49	47	47	44	..	44	..	35	..	..	41	48	
" 10, 14	..	34	..	..	..	39	47	41	47	46	41	38	42	39	42	15	41	43	52	37	..	..	..
1929, 9, 22	42	31	37	37	40	33	37	42	44	38	31	45	41	48	45	..	40	40	40	35	46	39	..	
1930, 8, 31	44	49	46	46	51	53	46	56	46	48	42	51	52	49	49	50	45	47	47	31	35	..	30	
1932, 8, 11	38	..	..	52	47	..	45	48	48	38	39	47	43	..	..	41	..	32	..	..	..	..	36
1933, 6, 27	41	43	43	43	37	50	42	42	42	31	30	48	39	..	25	..	41	41	41	..	..	..	49
" 9, 10	39	49	..	..	35	45	50	47	50	55	..	39	48	41	45	40	16	49	47	52	..	..	59
" 9, 16	50	47	50	55	..	40	46	51	45	40	46	49	47	52	..	59	..	..	..	47	47	..	51
" 10, 1	..	59	..	..	..	47	52	54	40	..	41	..	..	55	..	..	..	..	52	..	..	..	56
" 10, 26	..	55	42	..	49	59	65	49	48	31	..	..	45	49	..	..	..	43	48	42	..	..	46
1934, 6, 4	51	43	44	44	47	45	45	..	52	56	52	45	46	..	..	61	..	..	..	..	..	..	57
" 9, 5	45	48	..	..	..	37	39	45	51	53	53	50	52	47	43	49	47	49	47	51	48	..	..
" 10, 1	54	51	..	52	49	39	50	47	..	..	44	51	47	47	54	52	51	..	54	..	43	59	57
" 11, 21	53	..	..	52	58	..	..	..	49	52	48	49	51	..	50	45	58	54	49	51	50	55	51
1935, 10, 19	..	..	46	44	..	49	48	55	52	48	..	33	31	..	47	41	..	52	..	18	50	50	45
1936, 7, 27	..	40	..	..	49	50	46	39	45	45	49	47	43	44	42	43	..	..	..	..	..	..	44
" 8, 28	..	..	45	41	41	45	49	47	45	42	..	..	52	..	..	..	..	..	36	..	38	41	39
" 9, 8	..	52	..	..	..	..	36	..	..	38	41	39	..	43	40	38	40	41	44	41	38	50	55
" 9, 24	40	41	44	41	38	50	55	54	52	49	51	57	42	44	47	41	45	43	47	42	..	..	..
1937, 9, 14	..	38	41	52	48	50	43	47	51	46	48	..	48	59	47	47	46	51	46	43	30	36	..	
" 9, 20	43	47	51	46	48	..	48	59	47	47	46	51	46	43	43	30	36	38	36	40	43	40	..	
1938, 8, 14	..	..	41	48	50	49	..	..	51	49	49	43	46	42	46	47	48	46	..	50	42	..	..
" 8, 23	51	49	49	43	46	42	46	47	48	46	..	50	42	..	41	48	..	..	..	..	..	..	49
" 9, 16	52	..	..	46	38	48	48	50	48	33	..	..	39	47	45	53	42	46	48	51	50	46	49
" 10, 12	42	..	35	54	38	..	..	53	..	31	33	50	51	..	..	52	42	39	46	33	38	38	..
1939, 10, 12	52	42	39	46	33	38	38	..	44	41	22	31	28	36	..	..	..	..	..	..	43	35	38
" 10, 29	..	..	49	50	50	48	..	..	52	51	42	57	53	..	50	..	50	..	51	49	51	47	..
1940, 8, 5	..	..	48	53	..	..	..	..	..	47	47	56	..	48	55	64	55	..	..	..	..	..	..
" 8, 30	51	55	52	53	..	..	..	..	..	46	..	..	60	41	63	55	..	..	61	55	58	57	..
" 9, 11	56	..	..	..	..	..	..	..	..	49	48	56	54	..	66	..	..	..	..	..	..	..	51
1941, 9, 18	..	..	..	..	..	..	..	..	..	49	48	56	54	..	66	..	..	..	..	..	..	..	..
" 10, 3	55	..	..	..	..	..	51	..	42	59	55	57	52	58	52	48	..	..	49	53	51	51	..

1942, 8, 21	51	47	42	..	47	41	41	53	49	39	47	51	50	..	43	30	43	30	45	49	..	44	
" 11, 5	50	46	50	46	..	46	45	47	47	47	..	42	..	38	41	52	47	51	45	53	51	50	
1943, 7, 26	32	..	47	49	48	49	48	47	49	..	48	..	54	52	52	52	47	49	44	46	53	43	
" 8, 30	..	52	54	55	52	54	52	48	57	52	41	47	45	47	47	51	49	51	43	39	..	38	
" 9, 11	..	46	47	47	51	51	49	51	43	39	35	45	49	50	49	..	51	50	54	45	..	44	
1944, 7, 30	..	..	..	..	41	30	..	32	43	44	52	28	10	..	44	45	50	51	43	44	39	47
" 8, 16	41	45	50	51	43	41	39	47	45	29	25	41	40	43	45	41	..	..	58	..	..	..
1945, 6, 20	49	48	46	43	42	37	39	43	45	47	46	..	..	..	46	51	39	47	47	..	..	45
" 8, 23	43	44	42	..	46	..	..	21	36	04	21	..	30	34	..	..	..	..	..	..	..	..
1946, 9, 14	..	..	..	..	40	45	48	51	48	44	46	49	..	41	40	40	39	..	..	..	..	..
Sums,	1436	1450	1497	1577	1686	1536	1632	1551	1751	1931	1605	1601	1680	1637	1453	1529	1271	1536	1533	1319	1336	1382	1400
Numbers	30	31	32	34	37	33	35	34	38	43	38	35	37	35	31	33	27	33	33	29	29	30	30
Means	47.9	46.9	46.8	46.4	47.6	46.5	46.6	45.6	46.1	44.9	42.2	45.7	45.1	46.8	46.9	40.3	47.1	46.5	46.5	46.1	46.1	46.7	46.7
Means of threes	47.2	46.5	46.1	46.4	46.6	46.1	46.4	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6	46.6

TABLE 4.—Mean values of solar constant from 17 fragmentary sequences

Days from 1st report	—10	—9	—8	—7	—6	—5	—4	—3	—2	—1	0	1	2	3	4	5	6	7	8	9	10	11	12
No. of days Number re- porting	9	11	8	10	12	11	14	11	15	11	8	9	11	10	10	8	9	8	10	11	13	12	15
Mean values	5.02	4.35	4.76	4.36	4.33	4.44	4.41	4.45	4.33	4.19	4.51	4.34	4.27	4.39	4.35	4.11	4.33	4.26	4.36	4.59	4.13	4.42	4.35
Means of threes	4.74	4.38	4.30	4.34	4.23	4.30	4.34	4.23	4.30	4.36	4.30	4.34	4.23	4.30	4.36	4.30	4.36	4.30	4.36	4.30	4.36	4.30	4.36

the solar constant. If in any column it happens that fragments of sequences remain representing periods of prevailingly high solar constant, and in another column the fragments which remain represent prevailingly low periods of the solar constant, the two means are not comparable. Unfortunately the mean at the hurricane day is among the weakest in table 4, having fewest observations, only 8 out

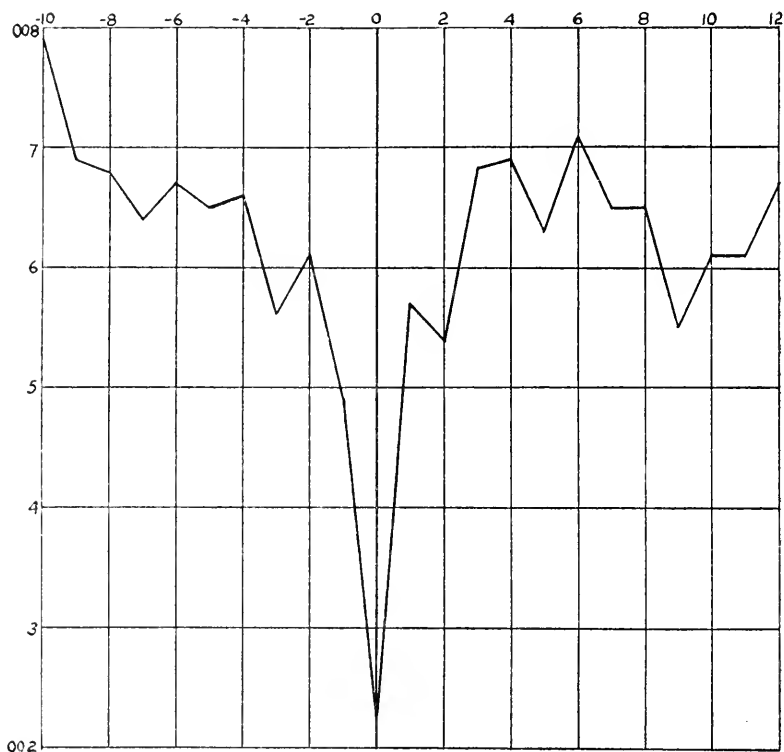


FIG. 1.—Mean solar-constant values preceding and following first reports of West Indian hurricanes. Abscissae, days before and after report dates; ordinates, solar-constant values, to be prefixed by 1.94.

of 17 cases reporting. Despite the paucity and raggedness of these data, they tend, on the whole, in the same sense as table 3. That is, the solar constant tends to decrease before the hurricanes, and does not quite recover to its former average value within 12 days afterward.

Although we may wish that stations better even than Montezuma might have been available, so that solar-constant values could have been more accurate and more complete, the results of this investiga-

tion, and of those that I have described in several earlier papers,¹ show that these solar-constant values are useful, that they disclose solar variations which are correlated with solar and terrestrial events, and that the variations of solar radiation are of major importance for meteorology.

Although the present research shows, I think definitely, the importance of solar variation in starting West Indian hurricanes, it cannot serve as a basis for predicting them for several reasons. First, the depression of solar radiation is not clearly marked until the beginning of a hurricane is already observed. Second, it appears that a considerable proportion (though still a small minority) of the hurricanes start without the impulse of a fall in solar radiation. Third, no doubt depressions of solar radiation occur, even in the hurricane season, when conditions are not ripe for a cataclysm. Finally, even if the probable formation of a hurricane could at some future time be anticipated for a few days by aid of greatly improved solar observations, there would still be no way to predict where it would start, or whither it would travel.

What has been accomplished here is, first, to show that changes of solar radiation are of importance in starting hurricanes; second, to confirm earlier impressions that Smithsonian solar-constant values, imperfect and incomplete as they are, still are helpful in the discussion of meteorological phenomena.

¹ Smithsonian Misc. Coll., vol. 94, No. 10, 1935; vol. 95, No. 12, 1936; vol. 95, No. 15, 1936; vol. 101, No. 1, 1941; vol. 104, No. 5, 1944; vol. 104, No. 12, 1945; vol. 104, No. 13, 1945; vol. 107, No. 4, 1947; vol. 107, No. 9, 1947; vol. 107, No. 10, 1947. See also Ann. Rep. Smithsonian Inst. for 1935, pp. 93-115, and for 1944, pp. 119-154. Also, of course, vol. 6, Annals, Astrophysical Observatory of the Smithsonian Institution.

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 110, NUMBER 2

INFLUENCE OF ILLUMINATION ON
REDUCING SUGAR CONTENT OF
ETIOLATED BARLEY AND
OAT SEEDLINGS

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(PUBLICATION 3917)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
MARCH 10, 1948

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

INFLUENCE OF ILLUMINATION ON REDUCING SUGAR CONTENT OF ETIOLATED BARLEY AND OAT SEEDLINGS

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Increased rate of carbon dioxide production following illumination of etiolated barley seedlings was observed by Weintraub and Johnston (1944). A possible mechanism for this effect is suggested by the finding of Parija and Saran (1934) of increased reducing sugar content caused by brief illumination of starved *Aralia* leaves, in conjunction with the numerous reports in the literature of an intimate relation between respiratory rate and reducing sugar content of plants. In order to test this possibility experiments have been conducted to ascertain whether changes in the reducing sugar content of etiolated cereal seedlings are produced by illumination of relatively short duration.

"Seeds"² of barley (varieties Hannechen and Sunrise) and of oats (variety Markton) were planted on filter-paper-covered porous stone wicks and allowed to germinate at room temperature in total darkness. At suitable ages, seedlings were exposed to the unfiltered radiation from a frosted tungsten filament lamp for periods of 60 to 200 minutes, at the end of which they were harvested.

For the sugar analyses, the shoots were severed just above the seeds, cut rapidly into small pieces with scissors, and placed in light-tight aluminum cans for weighing. Unilluminated plants were similarly sampled at the same time, the operations being performed in absence of light. The fresh weights were determined as rapidly as possible and the tissues transferred quickly to boiling 95-percent ethyl alcohol. Tests showed that reducing substances were removed completely after three additional extractions with boiling 80-percent alcohol; this procedure was followed throughout. The alcohol was removed from the combined extracts on a water bath and replaced by water.

Reducing power was estimated with the copper-iodometric reagent #50 of Shaffer and Somogyi (1933). In some experiments total

¹ Now with the Department of the Army, Camp Detrick, Frederick, Md.

² Kindly supplied by Merritt N. Pope and T. Ray Stanton of the U. S. Department of Agriculture.

reducing substance was measured after clearing the aqueous solutions by treatment with neutral lead acetate and potassium oxalate. In others, only the fermentable reducing substance was determined, from the difference between analyses before and after treatment of the unclarified solutions with various yeasts.³ In either case sugar was responsible for all, or very nearly all, the reducing power found and, as shown by the fermentation tests, consisted practically entirely of glucose or fructose, or both.

TABLE I.—*Influence of illumination on reducing sugar content of etiolated seedlings*

Exp.	Species	Age (days)	Illumination		Mgm. glucose equivalents per gm. fresh weight	
			Intensity (f. c.)	Duration (min.)	Before illumination	After illumination
1...	<i>Hordeum vulgare</i> var. Hannchen	6	20	60	18.0 2.0 ^a	18.1 2.1 ^a
2...	<i>Hordeum vulgare</i> var. Sunrise	7	25 150	200 200	19.6 19.6	18.7 19.0
3...	<i>Hordeum vulgare</i> var. Sunrise	7	25	165	18.5	16.8
4...	<i>Hordeum vulgare</i> var. Sunrise	8	25	195	12.6	12.6
5...	<i>Avena sativa</i> var. Markton	6	25	180	21.2	21.0
6...	<i>Avena sativa</i> var. Markton	6	20	60	22.4 ^b	22.3 ^b
7...	<i>Avena sativa</i> var. Markton	7	20	60	23.8	23.8

^a Mgm. sucrose per gm. tissue.

^b Leaf blades only.

In a few experiments sucrose also was estimated from the increase in reducing power after hydrolysis by invertase.

Table I summarizes the results obtained with seedlings such as had been found previously to exhibit increased carbon dioxide production after illumination. Each figure represents the average of two or three lots of plants. The values are expressed in terms of fresh weight of tissue. Substantially the same relative results were found if calculated on the basis of dry weight of the extracted tissue.

The data show that, under the experimental conditions employed, the content of reducing sugar is not increased by illumination. Hence

³ We are indebted to Dr. Lynferd J. Wickerham, of the Northern Regional Research Laboratory, U.S.D.A., for cultures of yeasts with specific fermentative ability.

the observed stimulation of carbon dioxide evolution by light does not appear to be attributable to increased sugar content.

These results are not necessarily contradictory to those of Parija and Saran as the nature and condition of the plant material were quite different in the two investigations. The sugar content of the detached *Aralia* leaves was only about one-hundredth as great as in the week-old grass seedlings, and it is not unlikely that metabolism follows a different path under such a condition of starvation. Oat seedlings grown in darkness for a longer time (2 to 3 weeks) were found to exhibit a rapid decline in reducing sugar and in some experiments showed appreciable increases following illumination. This was the case also with old detached tomato shoots which had been kept in the dark for a few days. However, as such plants generally have an unhealthy appearance and show a considerable degree of variability, the significance of this finding is not clear and the experiments have not been pursued.

Summary.—Sugar analyses indicate that the increased rate of carbon dioxide production which follows illumination of etiolated barley seedlings is not due to an increased content of reducing sugar or sucrose.

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SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 110, NUMBER 3

THE AMPHIPODA OF THE
SMITHSONIAN-ROEBLING EXPEDITION
TO CUBA IN 1937

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(PUBLICATION 3918)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
APRIL 30, 1948

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

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The amphipods of the Smithsonian-Roebbling Expedition were taken in Corrientes Bay and in the vicinity of the Isle of Pines on the southwest coast of Cuba, in comparatively shallow waters. Many of the specimens were collected by means of the submarine electric light, which was used at a number of stations with considerable success. The Gammaridea are represented by 9 families, 10 genera, and 11 species. The Hyperiidea are represented by 3 families, 6 genera, and 8 species. Two species, *Pontogeneia bartschi* and *Ceradocus shcardi*, are new to science.

STATIONS AT WHICH AMPHIPODS WERE TAKEN

STATION 30. Bahía Corrientes, Meyers anchorage, April 6, 1937.

STATIONS 48, 49, and 52. Bahía Corrientes, Corrientes anchorage, submarine light, April 8, 1937.

STATIONS 78, 88, and 89. Bahía Corrientes, Corrientes anchorage, submarine light, April 9, 1937.

STATION 100. Cayos San Felipe, submarine light, April 10, 1937.

STATION 112. Shore collecting, Sigüanea Bay, opposite Sigüanea Island, Isle of Pines, April 11, 1937.

STATION 124. Sigüanea Bay, dredge, 12 to 26 feet, April 11, 1937.

STATION 169. Lat. $21^{\circ}57'15''$ N., Long. $82^{\circ}32'45''$ W., April 15, 1937.

Order GAMMARIDEA

Family LYSIANASSIDAE

SHOEMAKERELLA NASUTA (Dana)

Lysianassa nasuta DANA, 1853 and 1855, United States Exploring Expedition, Crustacea, vol. 13, II, p. 915, pl. 62, fig. 2a-m.

Lysianax cubensis STEBBING, 1897, Trans. Linn. Soc. London, ser. 2, vol. 7, p. 29, pl. 7B.

- Lysianopsis alba* PEARSE, 1912, Proc. U. S. Nat. Mus., vol. 43, p. 369, fig. 1.
Lysianopsis alba SHOEMAKER, 1921, Univ. Iowa Stud. Nat. Hist., vol. 9, No. 5,
 p. 99.
Lysianassa cubensis SHOEMAKER, 1935, New York Acad. Sci. Scientific Survey
 of Porto Rico and the Virgin Islands, vol. 15, pt. 2, p. 232, fig. 1.
Shoemakerella nasuta PIRLOT, 1936, in Max Weber, *Siboga* Expeditie, vol. 33e,
 p. 265.
Shoemakerella nasuta PIRLOT, 1939, Mem. Mus. Roy. Hist. Nat. Belgique,
 2d ser., fasc. 15, p. 47.

Station 169, 2 specimens ♀.

This species was described by Dana from Rio de Janeiro, Brazil, and it has since been recorded from Barbados, Puerto Rico, Cuba, Tortugas and the coast of Florida, and *Albatross* station 2369-74 (northeastern part of the Gulf of Mexico). The animal measures about 10 mm. in length.

Family PHOXOCEPHALIDAE

PONTHARPINIA FLORIDANA Shoemaker

- Pontharpinia floridana* SHOEMAKER, 1933, Amer. Mus. Novit., No. 598, p. 5,
 figs. 3, 4.

Station 48, 2 specimens; station 49, 2 specimens; station 112,
 2 specimens.

This species was described from off Key Largo, Fla. There are in the collection of the United States National Museum specimens from Skull Creek, S. C., and from off Sable Island lighthouse, Ga. The species measures 6 to 8 mm.

Family LEUCOTHOIDAE

LEUCOTHOE SPINICARPA (Abildgaard)

- Gammarus spinicarpa* ABILDGAARD, 1789, in O. F. Müller, Zoologia Danica seu
 Animalium Daniae et Norvegiae rariorum ac minus notorum Descriptiones
 et Historia, ed. 3, vol. 3, p. 66, pl. 119, fig. 1.
Leucothoe spinicarpa SARS, 1892, Crust. Norway, vol. 1, p. 283, pl. 100.
Leucothoe spinicarpa STEBBING, 1906, Das Tierreich, Amphipoda I, Gammaridea,
 p. 165 (literature).

Station 124, 2 specimens; station 169, 1 specimen.

This is a cosmopolitan species and has been frequently taken on the east coast of the United States. It has also been taken in the Gulf of Mexico and the West Indies. This species measures from 14 to 18 mm. in length.

Family SYNOPIIDAE

SYNOPIA ULTRAMARINA Dana

Synopia ultramarina DANA, 1853 and 1855, United States Exploring Expedition, Crustacea, vol. 13, II, p. 995, pl. 68, fig. 6a-b.

Synopia ultramarina STEBBING, 1906, Das Tierreich, Amphipoda I, Gammaridea, p. 271.

Synopia schélcana BOVALLIUS, 1886, Nova Acta Reg. Soc. Sci. Upsala, ser. 3, vol. 13, No. 9, p. 16, pl. 2, figs. 22-29.

Synopia ultramarina SHOEMAKER, 1945, Amphipoda of the Bermuda Oceanographic Expedition 1929-1931, p. 195, fig. 8.

Station 30, about 50 specimens; station 48, 3 specimens; station 49, 1 specimen; station 52, 4 specimens; station 78, 1 specimen; station 89, 15 specimens; station 112, 18 specimens.

Widely distributed in all tropical and subtropical seas. The species usually measures from 2 to 5 mm., but specimens may reach 7 mm. in length.

Family BATEIDAE

CARINOBATEA CUSPIDATA Shoemaker

Carinobatea cuspidata SHOEMAKER, 1926, Proc. U. S. Nat. Mus., vol. 68, p. 21, figs. 14, 15.

Carinobatea cuspidata SHOEMAKER, 1933, Amer. Mus. Novit., No. 598, p. 11.

Carinobatea cuspidata SHOEMAKER, 1935, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, vol. 15, pt. 2, p. 235.

Station 78, 1 specimen; station 89, 6 specimens; station 124, 8 specimens.

This species was described from St. Thomas, Virgin Islands. It has since been taken at Puerto Rico and the west coast of Florida. The animal measures about 5 mm. in length.

CARINOBATEA CARINATA Shoemaker

Carinobatea carinata SHOEMAKER, 1926, Proc. U. S. Nat. Mus., vol. 68, p. 24, fig. 16.

Station 169, 1 specimen.

This species was described from the west coast of Florida. The present record from off the Isle of Pines is the second of its occurrence. The animal measures about 5 mm. in length.

Family PONTOGENEIIDAE

The difficulties of the family Pontogeneiidae and the confusion existing among its genera have been discussed by Schellenberg¹.

¹ Schellenberg, A., Revision der Amphipoden-Familie Pontogeneiidae. Zool. Anz., Bd. 85, Heft 11-12, pp. 273-282, 1929.

Stephensen², Nicholls³, and others. Schellenberg has produced a key which, as Nicholls remarks, "has made the task of separating members of the various genera a comparatively simple one." The species which I am here describing, while obviously a member of the Pontogeneiidae, does not possess a combination of characters agreeing with any of the genera as keyed by Schellenberg. In the present species the fourth joint of the second antenna is longer than the fifth; the carpus of the gnathopods is not elongate; the fourth coxal plate is very shallowly excavate; the telson is cleft to base; and the branchiae are not simple but rather complex.

PONTOGENEIA BARTSCHI new species

FIGURE 1

Station 30, about 50 specimens; station 48, about 50 specimens; station 49, about 50 specimens; station 52, about 25 specimens; station 78, about 50 specimens; station 88, 5 specimens; station 89, about 100 specimens; station 100, many thousands of specimens.

Male.—Head with very short rostrum; lateral lobes broadly rounding; eye very large and black. Antenna 1 shorter than 2; first joint nearly twice as long as second, which is twice as long as third; first peduncular joint bearing only groups of very fine setae on under surface; second peduncular joint bearing calceoli on its under surface; third peduncular joint is without accessory flagellum, but is expanded distally on the inner side into a shallow lobe bearing a few calceoli; flagellum long and slender and composed of many joints, each of which bears a calceolus and two or three sensory filaments on its under distal edge. Antenna 2, fourth joint longer than fifth and both with calceoli on the upper surface; flagellum composed of many joints, each of which bears a calceolus and two sensory filaments on its upper distal edge.

Mandible normal, cutting edge rather narrow and armed with short blunt teeth; accessory plate small, simple, and armed with short teeth; three spines in spine row; molar strong; palp strong, second joint longer than third and somewhat expanded. Maxilla 1, inner plate small and bearing 3 distal plumose setae; outer plate bearing 11 spine teeth; second joint of palp armed distally with 4 slender teeth and

² Stephensen, K., Crustacea from the Auckland and Campbell Islands. Vidensk. Medd. Dansk Naturh. Foren., Bd. 83, pp. 315-342, 1927.

³ Nicholls, G. E., Australian Antarctic Expedition 1911-14, Scientific Reports, Ser. C., Zoology and Botany, vol. 2, pt. 4, Amphipod Gammaridea, pp. 100-122, 1938.

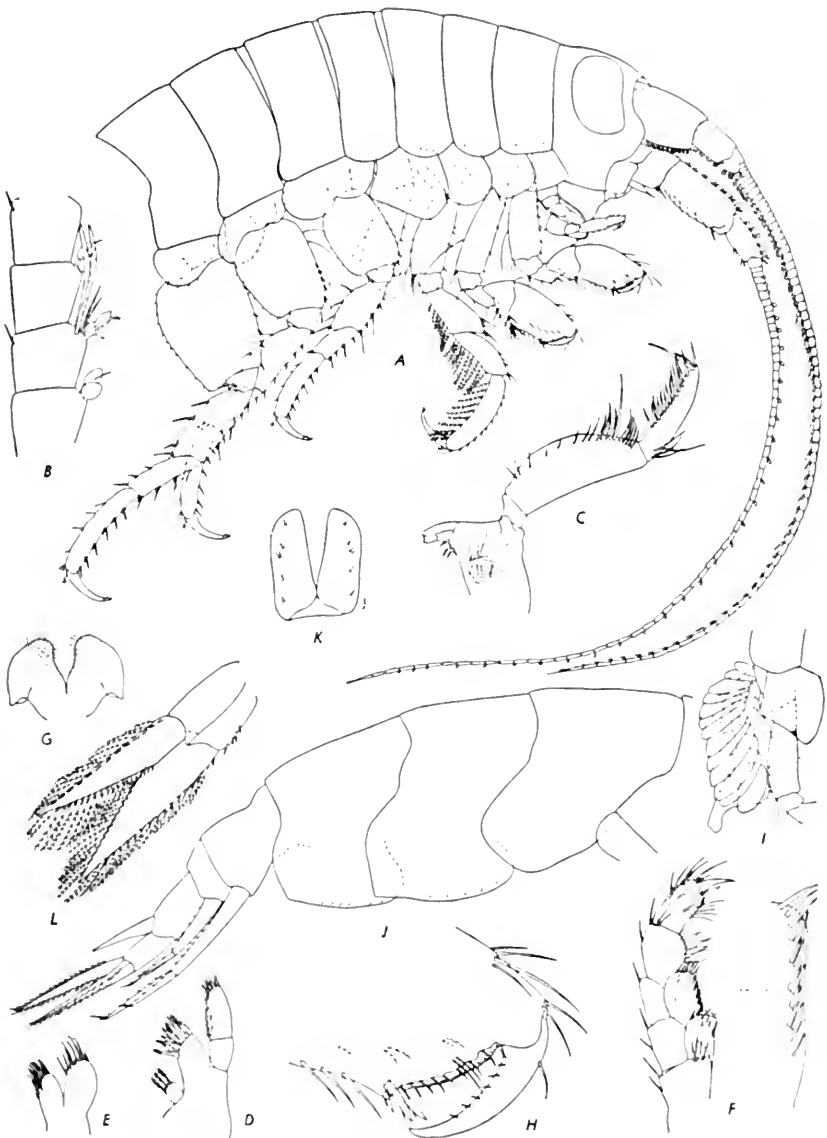


FIG. 1.—*Pontogeneia bartschi* new species. Male, a, front end of animal; b, a few segments of antenna 1, greatly enlarged; c, mandible; d, maxilla 1; e, maxilla 2; f, maxilliped; g, lower lip; h, distal end of gnathopod 1; i, peraeopod 2 showing side plate and the complex branchia; j, hind end of animal; k, telson; l, uropod 3.

4 setae. Maxilla 2, inner lobe narrower than outer and without oblique row of setae. Maxilliped, inner lobe not reaching to base of palp and armed distally with three strong teeth, one slender spine tooth, and several curved setae; outer lobe reaching just beyond the first joint of palp, armed with a row of submarginal spine teeth arranged in pairs, and bearing distally several curved spines; palp rather short and stout, third joint produced distally into a small lobe at the base of the dactyl. Upper lip with lower margin broadly rounding. Lower lip with inner lobes scarcely perceptible and mandibular processes short and rather blunt.

Gnathopods rather slender and weak and much alike in size and shape. Gnathopod 1, fifth joint as long as wide with lower margin scarcely at all produced; sixth joint about twice as long as wide, palm oblique, finely serrulate throughout and defined by a slight angle which is armed on the outer surface with one long and one short spine and on the inner surface with two long spines. Seventh joint fitting palm and bearing about six short setae on inner margin. Gnathopod 2 like 1 except that the fifth joint is produced below into a rather long, narrow lobe which lies against the base of the sixth joint. Peraeopods 1 and 2 alike in size and shape; fourth joint slightly expanded; fourth, fifth, and sixth joints bearing a row of plumose setae on the hind margin; seventh joint long, curved, and bearing a minute setule at base of nail. Peraeopods 3 to 5 increasing consecutively in length, the second joint considerably expanded. The coxal plates are all shallow and are shaped as shown in figure 1 A. Metasome segment 1 is rounding below; segment 2 is quadrate at lower hind corner; and lower hind corner of segment 3 is obtuse angled.

Uropods 1 and 2 slender and bearing a few short spines. Uropod 3 extending farther back than 1, rami broad and converging to a sharp point, their margins armed with spines and plumose setae. Telson extending beyond peduncle of uropod 3, cleft to its base, the lobes obliquely rounding distally and unarmed, but upper surface bearing a few submarginal setules. The branchiae are quite complex and consist of a series of overlapping lobes attached to a broad lamellar base which is strengthened at one edge by a thickened process resembling a vertebral column. Length from rostrum to end of uropod 3 about 6 mm.

Female.—The female closely resembles the male but is slightly smaller. It differs from the male as follows: the antennae are shorter, but bear calceoli as in the male; the gnathopods are smaller and weaker, though they are similar in structure to those of the male; the first and second peraeopods are without the plumose setae on the

fourth to sixth joints, but bear spines instead. Length of female from rostrum to end of uropod 3 about 5 mm.

Type.—A male, U.S.N.M. No. 80622, taken by Dr. Paul Bartsch at station 100, south coast of the west end of the western island of the Cayos San Felipe, Corrientes Bay, western end of Cuba, April 10, 1937.

Family GAMMARIDAE

CERADOCUS SHEARDI new species

FIGURE 2

Station 169. 12 specimens.

These specimens do not agree with any of the known species of *Ceradocus* as set forth in Keith Sheard's comprehensive paper "The Genus *Ceradocus*," Records of the Australian Museum, vol. 6, No. 3, 1939. I am therefore describing the species as new and naming it *Ceradocus sheardi* in honor of Mr. Sheard.

Male.—Antenna 1 about two-thirds the length of the body; first joint a little shorter than the second, lower margin bearing a distal spine, one near the center, and two smaller proximal spines; second joint without spines; flagellum longer than peduncle; accessory flagellum of about eight joints. Antenna 2, peduncle about equal in length to that of antenna 1; flagellum a little longer than the fifth peduncular joint and consisting of about 16 joints. Mandibular palp with third joint a little over one-third the length of the second. Maxilla 1, inner plate normal; outer plate with 9 spine teeth; palp with 18 slender terminal spines. Maxilla 2 normal. Maxillipeds, inner plate armed distally with three rather long teeth and several slender, curved spines, inner margin with a few plumose setae; outer plate armed on inner margin with about nine slender, curved teeth, and distally with slender, curved plumose spines and setae; palp with second joint reaching a little beyond outer plate. Lower lip with small inner lobes; mandibular processes or lateral lobes slender.

Gnathopod 1, sixth joint a little shorter than fifth; coxal plate with lower front corner produced. Gnathopod 2 with sixth joint very large and strong; palm convex distally and concave at the defining angle, which bears two stout spines. Peraeopods 1 and 2 very short. Peraeopods 3 to 5 increasing consecutively in length. Peraeopod 3, second joint with the lower posterior corner not produced downward into an angular lobe but narrowly rounding. The second joints of peraeopods 4 and 5 with the lower posterior corner rounding. Meta-some segments toothed as shown in figure 2 A. The posterior teeth of the first and second urosome segments do not appear to adhere to

a definite pattern. They do not always have a large mediiodorsal tooth nor are they evenly dentate. In the male that I have figured the first urosome segment possesses a large mediiodorsal tooth, but the second

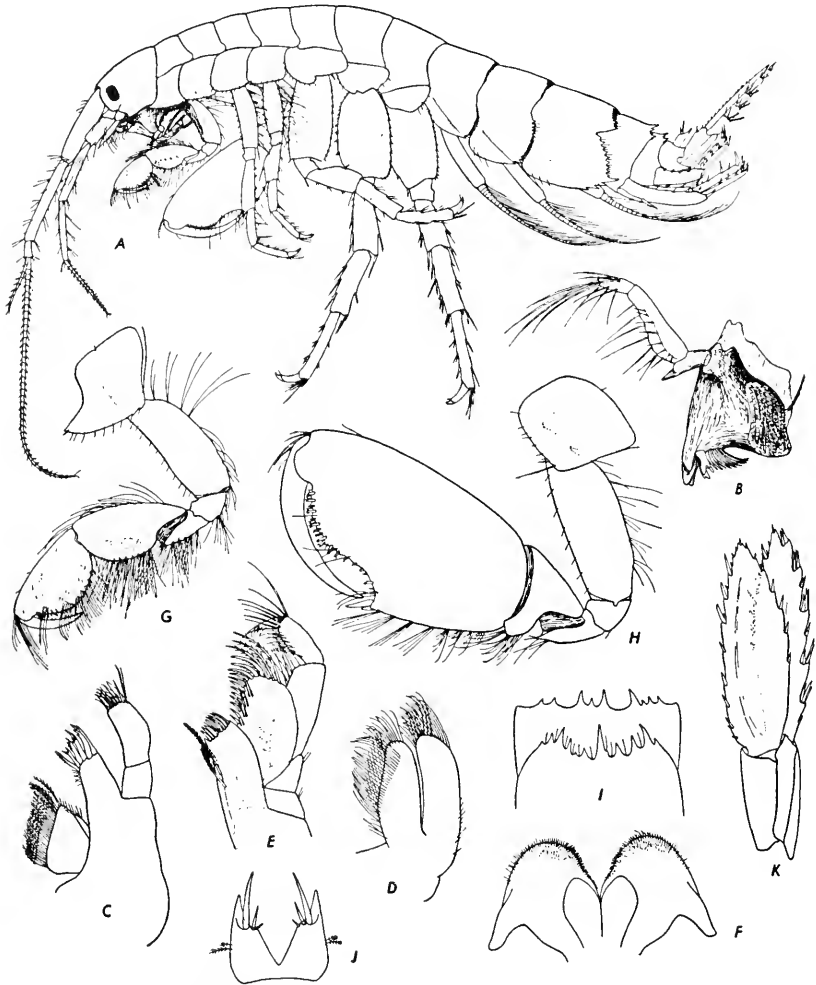


FIG. 2.—*Ceradocus sheardi* new species. Male, *a*, entire animal; *b*, mandible; *c*, maxilla 1; *d*, maxilla 2; *e*, maxilliped; *f*, lower lip; *g*, gnathopod 1; *h*, gnathopod 2; *i*, dorsal view of first and second urosome segments; *j*, telson; *k*, uropod 3.

segment does not (fig. 2 I). In most of the specimens the median tooth of the first urosome segment is larger than some of the adjacent teeth and in some of the specimens there is no median tooth on the

second urosome segment. Between the teeth of the metasome segments and those of the first urosome segment there is a seta, but between the teeth of the second urosome segment there are no setae.

Uropod 3 with rami rather broad, outer ramus bearing groups of stout spines on outer margin and a few spines on distal half of inner margin; inner ramus with spines on both margins. Telson not reaching to end of peduncle of uropod 3, deeply cleft, bearing three distal spines on each lobe, and two plumose setules or hairs on the lateral margins. Length of male from front of head to end of uropod 3, 14 mm.

Female.—The female does not differ materially from the male; even the gnathopods being like those of the male. The right and left gnathopods are alike in both sexes. The length is 14 mm.

Type.—A male, U.S.N.M. No. 81564, taken by Dr. Paul Bartsch at station 169 ($21^{\circ}57'15''$ N., $82^{\circ}32'45''$ W.), April 15, 1937.

In many characters this species agrees with *rubromaculatus*, but disagrees in others. The lower posterior corner of the third, fourth, and fifth pereopods is not produced angularly downward, but is evenly rounding. The palm of the second gnathopod is quite different, as is seen by comparison with Sheard's figure 2 F. The first and second urosome segments are not evenly dentate. The telson bears on each lobe three distal spines, the outer one of which is the longest and the inner one the shortest.

The male which I have figured was taken by the *Albatross* at station 2365, just north of Yucatan, in 24 fathoms. It has been taken also on the west coast of Florida, and at *Albatross* station 2369-74 in the northeastern part of the Gulf of Mexico, in 26 fathoms.

CERADOCUS sp.

Station 169, 1 specimen.

This specimen, an ovigerous female measuring about 10 mm., resembles *Ceradocus chiltoni* Sheard in several characters, but differs in others. The second gnathopods, the right and left of which are alike, very much resemble those of *C. chiltoni*, though the sixth joint is proportionally a little longer and narrower. The palm is toothed as shown by Sheard's figure 7 A, but the prominent defining angle bears two stout spines instead of one as shown in his figure. The lower posterior corner of the second joint of pereopods 3 to 5 is produced angularly downward. The teeth of the first and second urosome segments vary greatly in size, some of them being long and upward-curved. The

telson bears two long and two short spines distally on each lobe. The third uropods are missing. I refrain from describing and figuring this species, as there is only the one specimen.

ELASMOPUS POCILLIMANUS (Bate)

- Mocra pocillimanus* BATE, 1862, Cat. Amph. British Mus., p. 191, pl. 34, fig. 7.
Moera levis SMITH, 1873, in A. W. Verrill, Rep. U. S. Fish Comm. [1874], vol. 1, p. 559.
Elasmopus laevis PAULMIER, 1905, Bull. 91, Zoology 12, New York State Mus., Albany, p. 162, fig. 32.
Elasmopus laevis HOLMES, 1905, Bull. Bur. Fisheries for 1904, vol. 24, p. 507, fig.
Elasmopus pocillimanus STEBBING, 1906, Das Tierreich, Amphipoda I, Gammaridea, p. 443.
Elasmopus pocillimanus KUNKEL, 1910, Connecticut Acad. Arts and Sci., vol. 16, p. 56, fig. 21.
Elasmopus pocillimanus CHEVREUX, 1911, Mem. Soc. Zool., vol. 23, p. 225, pl. 16, figs. 1, 2.
Elasmopus levis FOWLER, 1912, Ann. Rep. New Jersey State Mus. [1911], p. 197, pl. 58.
Elasmopus pocillimanus CHEVREUX and FAGE, 1925, Faune de France, 9, Amph., p. 246, fig. 257.
Elasmopus pocillimanus SHOEMAKER, 1935, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, vol. 15, pt. 2, p. 239.
Elasmopus pocillimanus SCHELLENBERG, 1938, Kungl. Svenska Vetensk. Akad. Handlingar, 3d ser., vol. 16, No. 6, p. 56, fig. 28.

Station 124, 12 specimens; station 169, 3 specimens.

Elasmopus pocillimanus was described from Genoa, Italy, and it occurs on the east coast of the United States from southern New England to the Gulf of Mexico. It has also been recorded from Bermuda, Puerto Rico, Cape Verde Islands, Annobon Island, West Africa, and the Gilbert Islands (Schellenberg). The animal measures about 10 mm. in length.

Note.—In 1916 K. H. Barnard (Ann. South African Mus., vol. 15, pt. 3, p. 200, pl. 27, fig. 15) described a species *Elasmopus levis* from South Africa, but S. I. Smith's species *Moera levis*, described in 1873, was transferred to the genus *Elasmopus* by F. C. Paulmier in 1905. Barnard's name thus becomes a homonym and will have to be discarded. I therefore propose the new name *Elasmopus barnardi* for Barnard's species.

Family TALITRIDAE

PARHYALELLA WHELPLEYI (Shoemaker)

Hyalella whelpleyi SHOEMAKER, 1933, Amer. Mus. Novit., No. 598, p. 23, figs. 12, 13.

Station 78, 1 specimen.

This species was described from Trinidad, British West Indies, and the present record from Cuba is the second of its occurrence.

Parhyalella whelpleyi may prove to be a synonym of the genotype, *Parhyalella batesoni*, described by Kunkel from Bermuda in 1910. Kunkel's figures are greatly lacking in detail, and his description does not mention the characters which I consider specific in *P. whelpleyi*. The identity of these two species will have to remain in abeyance until material can be obtained from Bermuda for comparison. This species measures about 6 mm. in length.

Family COROPHIDAE

GRANDIDIERELLA BONNIERI Stebbing

FIGURE 3

Grandidierella bonnicri STEBBING, 1908, Rec. Indian Mus., vol. 2, pt. 2, No. 13, p. 120, pl. 6.

Grandidierella megnac CHILTON, 1921, Mem. Indian Mus., vol. 5, p. 548, fig. 10b, e-ī (form 1).

Unciolella lunata SCHELLENBERG, 1928, Trans. Zool. Soc. London, vol. 22, pt. 5, p. 669, fig. 207.

Grandidierella megnac STEPHENSEN, 1933, Zool. Jahrb., Bd. 64, Heft 3 5, pp. 434, 446.

Grandidierella bonnicri BARNARD, 1935, Rec. Indian Mus., vol. 37, pt. 3, p. 299, figs. 12d, 13b (literature).

Grandidierella bonnicri SCHELLENBERG, 1938, Zool. Jahrb., Bd. 71, Heft 3, p. 215.

Station 124, 1 specimen ♂.

This species was described from brackish pools at Port Canning, Lower Bengal, India, in 1908. Dr. Chas. Chilton recorded it from Chilka Lake (*G. megnac*) in 1921. Dr. A. Schellenberg recorded it from the Suez Canal (*Unciolella lunata*) in 1928. In 1933 Dr. K. Stephensen recorded it from the Island of Bonaire (*G. megnac*) off the coast of Venezuela. K. H. Barnard recorded it again from the coast of India in 1935. In 1938 Dr. A. Schellenberg recorded it from the coast of Brazil. It is now recorded from Cuba, and, as shown by material in the collections of the United States National Museum, it is widely distributed in the West Indian and Caribbean regions. The length of the species from front of head to end of third uropod is 6 to 7 mm.

Order HYPERIIDEA

Family HYPERIIDAE

HYPERIA BENGALENSIS (Giles)

Lestrigonus bengalensis GILES, 1887, Journ. Asiatic Soc. Bengal, vol. 56, pt. 2, p. 224, pls. 6, 7.

Hyperia atlantica VOSSELER, 1901, Amph. Plankton Exped., I Theil, Hyperiidea I, p. 67, pl. 6, figs. 5-15.

Hyperia bengalensis PIRLOT, 1939, Résult. Camp. Sci. Prince de Monaco, fasc. 102, p. 35 (literature).

Station 30, 14 specimens; station 48, 13 specimens; station 49, 14

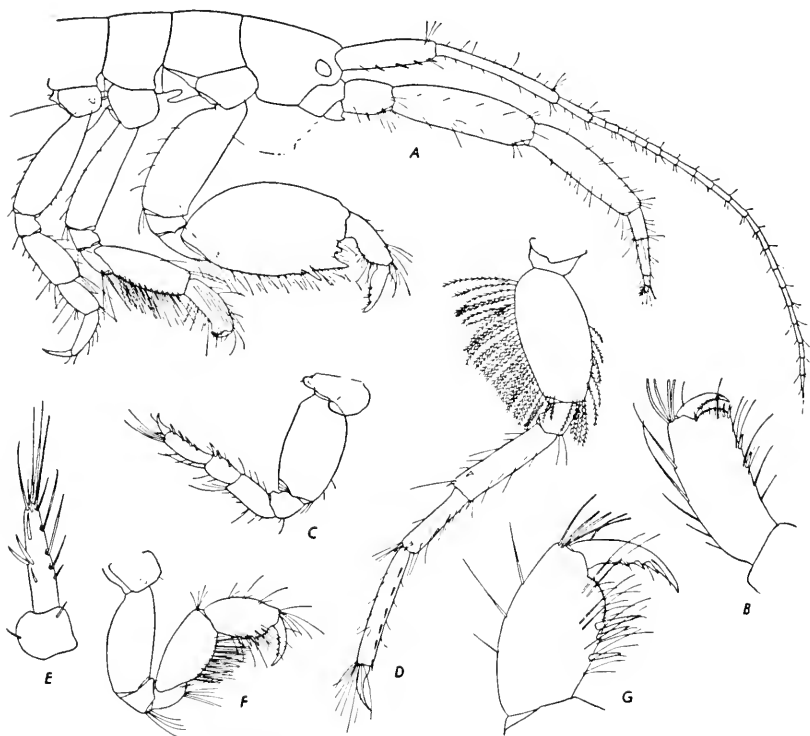


FIG. 3.—*Grandidierella bonnieri* Stebbing. Male, *a*, front end of animal; *b*, gnathopod 2; *c*, peraeopod 3; *d*, peraeopod 5; *e*, uropod 3. Female, *f*, gnathopod 1; *g*, sixth and seventh joints of gnathopod 1, enlarged.

specimens; station 52, 15 specimens; station 78, 1 specimen; station 89, 6 specimens.

PirLOT (1939, p. 102) has given what he considers to be the synonymy of this species. He includes as synonyms *Hyperia promontorii*, *dischystus*, *schizogeneios*, and *zebui* of Stebbing, *gilesi*, *latis-*

sima, *thoracica*, and *Themistella steenstrupi* of Bovallius, and *H. macrophthalma* and *hydrocephala* of Vosseler. *Hyperia promontorii* Stebbing, *Themistella steenstrupi* Bovallius, and *Hyperia atlantica* Vosseler appear to be the male of the same species, which I believe to be *H. bengalensis* (Giles). Dana's figure of *Hyperia fabreii* (United States Exploring Expedition, vol. 14, Atlas, pl. 67, fig. 10, 1855) is probably also a male of *H. bengalensis*. *Hyperia bengalensis*, a small species, the males of which measure about 4 mm., is widely distributed in the Atlantic, Pacific, and Indian Oceans. The present records are the first for the West Indies. In the present material are several ovigerous females measuring 3.5 mm.

Family LYCAEIDAE

BRACHYSCELUS CRUSCULUM Bate

Brachyscelus crusculum BATE, 1861, Ann. Mag. Nat. Hist., ser. 3, vol. 8, p. 7, pl. 2, figs. 1, 2.

Thamyris mediterranea CLAUS, 1887, Die Platysceliden, p. 60, pl. 16, figs. 11-18.

Brachyscelus crusculum PIRLOT, 1930, *Siboga* Expeditie, vol. 33a, pt. 1, p. 25 (literature).

Brachyscelus crusculum PIRLOT, 1930, Résult. Camp. Sci. Prince de Monaco, fasc. 102, p. 46.

Brachyscelus crusculum SHOEMAKER, 1945, Zoologica, New York Zool. Soc., vol. 30, pt. 4, p. 242.

Station 89, 1 specimen.

This is a widely distributed species, having been recorded from the North and South Atlantic, North Pacific, East Indies, Indian Ocean, and Mediterranean. The present record is the first from the West Indies. The species measures from 10 to 14 mm. in length.

BRACHYSCELUS GLOBICEPS (Claus)

Thamyris globiceps CLAUS, 1879, Arb. Zool. Inst. Wien, vol. 2, p. 182.

Thamyris globiceps CLAUS, 1887, Die Platysceliden, p. 59, pl. 16, figs. 1-2, 4-10.

Brachyscelus globiceps STEPHIENSEN, 1925, Danish Oceanographic Expedition 1908-1910, vol. 2, D.5, Hyperiiidea, pt. 3, p. 176, fig. 65.

Brachyscelus globiceps SHOEMAKER, 1945, Zoologica, New York Zool. Soc., vol. 30, pt. 4, p. 242.

Station 30, 5 specimens.

This species has been recorded from the Mediterranean, North and South Atlantic, Indian Ocean, and Australia. It has not heretofore been recorded from the West Indies. The animal measures about 6 mm. in length.

BRACHYSCELUS MACROCEPHALUS Stephensen

Brachyscelus macrocephalus STEPHENSEN, 1925, Danish Ingolf Expedition, vol. 3, p. 177, fig. 66.

Brachyscelus macrocephalus SHOEMAKER, 1945, Zoologica, New York Zool. Soc., vol. 30, pt. 4, p. 243.

Station 30, 1 specimen.

This species has been recorded from the Mediterranean and from Bermuda. The present record is the third of its occurrence. The species measures 5 or 6 mm. in length.

LYCAEA PULEX Marion

Lycaca pulex MARION, 1874, Ann. Sci. Nat., ser. 5, vol. 17, p. 13, pl. 2, fig. 2.

Lycaca pulex SHOEMAKER, 1945, Zoologica, New York Zool. Soc., vol. 30, pt. 4, p. 243 (literature).

Station 48, 2 specimens.

Lycaca pulex has been recorded from the North and South Atlantic, North and South Pacific, Indian Ocean, and Mediterranean. The present record is the first for the West Indies. The species measures from 4 to 6 mm.

Family PLATYSCELIDAE

AMPHITHYRUS SCULPTURATUS Claus

Amphithyrus sculpturatus CLAUS, 1887, Die Platysceliden, p. 41, pl. 7, figs. 1-9.

Amphithyrus orientalis STEBBING, 1888, *Challenger* Rep., p. 1485, pl. 210, fig. B.

Amphithyrus orientalis SHOEMAKER, 1925, Bull. Amer. Mus. Nat. Hist., vol. 52, p. 58, figs. 25, 26.

Amphithyrus sculpturatus STEPHENSEN, 1925, Danish Oceanographic Expedition 1908-1910, vol. 2, D.5, Hyperiidea, pt. 3, p. 226.

Amphithyrus sculpturatus SPANGL, 1927, Die Hyperiden der Deutschen Südpolar-Expedition 1901-1903, Deutsch. Südpolar-Exped., vol. 19, Zool. 11, p. 250.

Amphithyrus sculpturatus PIRLOT, 1929, Résultats Zoologiques Croisière atlantique de "l'Armauer Hansen," 1922, fasc. 1, p. 158.

Amphithyrus sculpturatus BARNARD, 1937, The John Murray Expedition 1933-34, Sci. Rep., vol. 4, No. 6, Amphipoda, p. 196.

Station 30, 2 specimens.

This species has been recorded from the Mediterranean, Atlantic Ocean, Arabian Sea, Pacific Ocean, and the Gulf of California. The present record is the first for the West Indies. Several specimens of *Amphithyrus similis* Claus were taken by Dr. William Beebe at Bermuda in 1931, and this species is regarded by Pirlot (1929, p. 158) as a synonym of *A. sculpturatus*. The species measures from 4 to 5 mm. in length.

PARATYPHIS MACULATUS Claus

- Paratyphis maculatus* CLAUS, 1887, Die Platysceliden, p. 39, pl. 5, figs. 1-9.
Paratyphis maculatus PIRLOT, 1939, Résult. Camp. Sci. Prince de Monaco, fasc. 102, p. 56.
Paratyphis maculatus SHOEMAKER, 1945, Zoologica, New York Zool. Soc., vol. 39, pt. 4, p. 259.

Station 30, 8 specimens; station 52, 1 specimen.

This species has been recorded from the North and South Atlantic, East Indies, and Gulf of Aden, but it has not heretofore been recorded from the West Indies. It is a small species measuring from 2 to 4 mm. in length.

TETRATHYRUS FORCIPATUS Claus

- Tetrathyrus forcipatus* CLAUS, 1887, Die Platysceliden, p. 40, pl. 5, figs. 10-18, pl. 6, figs. 1-3.
Tetrathyrus sancti-josephi SHOEMAKER, 1925, Bull. Amer. Mus. Nat. Hist., vol. 52, p. 54, figs. 22-24.
Tetrathyrus forcipatus SHOEMAKER, 1945, Zoologica, New York Zool. Soc., vol. 39, pt. 4, p. 256.

Station 30, 1 specimen; station 48, 25 specimens; station 49, 7 specimens; station 52, 1 specimen.

This species has been recorded from the North, tropical, and South Atlantic, Mediterranean, Red Sea, northern Arabian Sea, East Indies, New Zealand, and North Pacific. It is a small species measuring 3 to 4.5 mm.

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 110, NUMBER 4

Koebling Fund

1947-1948 REPORT ON THE
27.0074-DAY CYCLE IN WASHINGTON
PRECIPITATION

BY

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(PUBLICATION 3919)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
MARCH 10, 1948

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

Koebling Fund

1947-1948 REPORT ON THE 27.0074-DAY CYCLE IN WASHINGTON PRECIPITATION

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In Smithsonian Miscellaneous Collections¹ I have set forth an apparent cycle of precipitation at Washington, and the outcome from year to year of yearly predictions based thereon. In 1947, for the fourteenth consecutive year, the average precipitation for the predicted favorable days has exceeded the average precipitation on all other days of the year. The results for 1947 precipitation are given in table 1.

TABLE 1.—*Statistics of Washington precipitation, 1947*

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
"preferred" days	0.171	0.100	0.030	0.128	0.136	0.284	0.684	0.035	0.150	0.000	0.216	0.058	0.1176
other days	0.072	0.023	0.048	0.101	0.126	0.112	0.215	0.229	0.097	0.070	0.123	0.037	0.1058
ratio	2.38	4.29	0.62	1.22	1.08	2.54	0.34	0.19	1.55	0.60	1.75	1.57	1.10
total inches	3.72	1.65	1.21	3.37	4.05	5.76	5.35	3.08	3.70	1.31	5.09	1.17	40.39
normal inches	3.55	3.27	3.75	3.27	3.70	4.13	4.71	4.01	3.24	2.84	2.37	3.32	42.16
percent normal	105	50	33	103	109	139	114	92	114	46	215	34	96

Lines 1 and 2 give the average precipitation in inches per day for "preferred" and all other days. Line 3 gives the ratio: $\frac{\text{preferred}}{\text{other}}$. Lines 4 and 5 give the total precipitation and normal precipitation in inches, and line 6 the percentage of observed to normal for the months and year.

"Preferred" days had a higher average precipitation than all other days in the months January, February, April, May, June, September, November, and December, and also for the year 1947 as a whole. Other days had a higher average precipitation than "preferred" days in the months March, July, August, and October. Of these four exceptional months, March and October had very low rainfall. The average ratio, "preferred"/all other, of precipitation per day for 14 consecutive years has exceeded unity. The expectation is 1.42. The value for 1947 is 1.10, and for the 14 years it is 1.47.

The following table 2 gives the dates for 1948 when the average daily precipitation is expected to exceed the average for all other days. In the first column are given in Roman numerals the day numbers

¹ See Smithsonian Misc. Coll., vol. 104, Nos. 3 and 5, 1944; and vol. 107, No. 3, 1947.

within the 27 days of the cycle when higher precipitation is expected. The remainder of the table gives the actual dates in the different months which correspond to these Roman numerals, in other words the "preferred" days for the year 1948. These "preferred" days should give, on the average, higher precipitation than all other days.

TABLE 2.—*Predicted dates when average precipitation should exceed average precipitation for all other dates, Washington, 1948*

"Preferred" cycle places	Jan.	Feb.	Mar.	Apr.	May	June
I	12	8	6	2, 29	26	22
II	13	9	7	3, 30	27	23
III	14	10	8	4	1, 28	24
IV	15	11	9	5	2, 29	25
V	16	12	10	6	3, 30	26
XII	23	19	17	13	10	6
XIII	24	20	18	14	11	7
XV	26	22	20	16	13	9
XVII	1, 28	24	22	18	15	11
XVIII	2, 29	25	23	19	16	12
XXII	6	2, 29	27	23	20	16
XXVI	10	6	4, 31	27	24	20
XXVIII	11	7	5	1, 28	25	21

"Preferred" cycle places	July	Aug.	Sept.	Oct.	Nov.	Dec.
I	19	15	11	8	4	1, 28
II	20	16	12	9	5	2, 29
III	21	17	13	10	6	3, 30
IV	22	18	14	11	7	4, 31
V	23	19	15	12	8	5
XII	3, 30	26	22	19	15	12
XIII	4, 31	27	23	20	16	13
XV	6	2, 29	25	22	18	15
XVII	8	4, 31	27	24	20	17
XVIII	9	5	1, 28	25	21	18
XXII	13	9	5	2, 29	25	21
XXVI	17	13	9	6	2, 29	26
XXVII	18	14	10	7	3, 30	27

The tabulation on which the cycle of 27.0074 days is based began January 1, 1924. In the 24 years, 1924 to 1947, there were 8,766 days. To complete 325 cycles of 27.0074 days requires 8,777.4 days. Hence 11 days of January 1948 are required additional to the 24 years ending December 31, 1947. Thus I begin table 2 which follows with January 12, 1948, corresponding to Roman numeral I.

It should be emphasized that this prediction relates only to Washington, D. C.²

² This paper was finished on January 16, 1948.

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 110, NUMBER 5

Koebling Fund

SMITHSONIAN PYRHELIOMETRY AND
THE STANDARD SCALE OF
SOLAR RADIATION

BY
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(PUBLICATION 3920)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
APRIL 15, 1948

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

Roebbling Fund

SMITHSONIAN PYRHELIOMETRY AND THE STANDARD SCALE OF SOLAR RADIATION

BY L. B. ALDRICH AND C. G. ABBOT

Smithsonian Institution

Since its beginning in 1890, the Astrophysical Observatory of the Smithsonian Institution has devoted much time to the development and improvement of pyrhelimeters for the accurate measurement of total solar radiation. Numerous types have been investigated, and many thousands of individual measurements and intercomparisons of various pyrhelimeters have been made. The two that have been most useful and satisfactory for our purposes are the water-flow pyrhelimeter, a standard instrument, and the silver-disk pyrhelimeter, a secondary instrument.

During the past 40 years, Andrew Kramer, veteran instrument maker of the Astrophysical Observatory, has constructed in our shop nearly 100 silver-disk pyrhelimeters. Most of these instruments as completed have been sold or loaned to interested institutions and are now in use on every continent. The silver-disk instrument was devised and designed by Dr. Abbot. It is mechanically simple and rugged and with reasonable care it continues indefinitely to give reliable readings of solar radiation. Our faith in the permanence of the constant furnished with each instrument has been supported by many intercomparisons extending over long periods of time.¹ Since it is not practicable to use the silver-disk pyrhelimeter as a standard instrument, the constant of each one is determined by careful comparisons against a standard pyrhelimeter. One of our silver-disk instruments, A.P.O. No. 8_{bls} has been kept at the Observatory as a substandard since it was built 40 years ago, and a second one, S.I. No. 5_{bls} has been similarly used in recent years.

In the years 1910 to 1913, the Observatory conducted an intensive campaign to produce a standard pyrhelimeter, and to establish the correct standard scale of solar radiation. The water-flow and water-stir standard pyrhelimeters, both devised by Dr. Abbot, were selected

¹ See detailed tabulations of these comparisons in volumes 3 to 6 of the *Annals of the Astrophysical Observatory*.

for this work and many comparisons were made against various silver-disk instruments.² This campaign established a standard scale of radiation which we called the "Smithsonian revised pyrheliometry of 1913." The constants of all silver-disk pyrheliometers have been based on this scale. In the years 1915, 1916, and 1920 further comparisons were made against standard water-flow No. 3 on Mount Wilson, Calif., these results confirming the adopted scale of 1913.³

In 1932 a marked improvement was made in the standard water-flow pyrheliometer. This was suggested by V. M. Shulgin⁴ and consisted in the substitution of two identical absorbing chambers instead of one. The advantages of this change and others of a minor nature are discussed in our paper "An Improved Water-flow Pyrheliometer and the Standard Scale of Solar Radiation" (Smithsonian Misc. Coll., vol. 87, No. 15, 1932). The new pyrheliometer proved free from the worst difficulty we had experienced with the earlier instrument, namely, irregular drift of the galvanometer zero. The results now obtained were more concordant and more satisfactory than ever before. Thirty-seven comparisons between the new water-flow No. 5 and our silver-disk pyrheliometer S.I. No. 5_{bis} showed the scale of our revised pyrheliometry of 1913 to be too high by 2.5 percent. In 1934 we repeated this work on Mount Wilson.⁵ Forty-two comparisons showed the 1913 scale to be 2.3 percent too high.

Since 1934, 13 years have elapsed with no further comparisons against a water-flow standard. In August 1947 opportunity came to make further comparisons at Mount Wilson. In preparation for this, standard water-flow pyrheliometer No. 5 was altered as follows: New thermoelements of copper-constantan were substituted for the former nickel-platinum junctions. These and also the special glass housings for the thermoelements were made by L. B. Clark of this Institution in such form that the whole assembly could be waxed in place without the use of rubber tubing. On arrival at Mount Wilson, however, it was found that seams had opened up in the wax, owing probably to changes in temperature and jolting in transit from Washington. After considerable difficulty the wax was remelted and the whole made watertight.

All the precautions which we took in 1932 and 1934 to insure greater accuracy were again taken in the present comparisons. In addition, the following steps were taken:

² Ann. Astrophys. Obs., vol. 3, pp. 52-72, 1913.

³ Ann. Astrophys. Obs., vol. 4, pp. 92-97, 1922.

⁴ Monthly Weather Rev., August 1927, p. 361.

⁵ Smithsonian Misc. Coll., vol. 92, No. 13, 1934.

1. An eyepiece of improved design was used to read the silver-disk pyrheliometer.

2. The rate of the seconds pendulum was carefully adjusted to indicate exact 1-second intervals.

3. A high-sensitivity D'Arsonval galvanometer was used. The total deflection for uncompensated solar heating was 44 cm. as compared with 10 cm. in the previous work.

4. All current measurements were made with a direct-reading potentiometer, using a 3-ohm standard resistance and a certified standard cell. Currents with this arrangement were read to 1 part in 5,000.

Comparisons were made on 2 days, August 26 and 27. Excellent skies prevailed on both days. In all the comparisons, C. G. Abbot read the silver-disk pyrheliometer and operated the shutter of the standard pyrheliometer. L. B. Aldrich made the galvanometer and current measurements.

Two silver-disk instruments, S.I. No. 5_{bls} and S.I. No. 79 were used. They had been carried by hand, one by each of the authors, from Washington, D. C., to Mount Wilson. The adopted constant of S.I. No. 5_{bls} (Smithsonian scale of 1913), as stated in our previous papers, is .3715. That of S.I. No. 79, as determined from 32 comparisons against substandard A.P.O. No. 8_{bls} in November and December, 1946, is .3736.

The results of our comparisons are summarized in table 1. With S.I. No. 5_{bls}, the mean of 18 comparisons against standard No. 5 gives .3626 as the constant of S.I. No. 5_{bls}. Thus the ratio of Smithsonian revised scale of 1913 to the scale of standard No. 5 is

$$\frac{.3715}{.3626} = 1.0245.$$

The mean of 15 comparisons between S.I. No. 79 and Standard No. 5 gives .3650 as the constant of S.I. No. 79, and the ratio of the scale of 1913 to that of Standard No. 5 is

$$\frac{.3736}{.3650} = 1.0235.$$

It is interesting to note that the average deviation of individual comparisons is only one-half of one percent, and the probable error of the means one-tenth of one percent.

The mean ratio for all 33 comparisons is 1.0240.

In 1932, 37 comparisons gave a mean ratio of 1.0248. In 1934, 42 values gave 1.0237. Thus the 1932, 1934, and 1947 means agree within 1 part in 1,000. We conclude that the scale of Smithsonian revised pyrheliometry of 1913 is very nearly 2.4 percent too high. Our silver-disk instruments have remained unchanged.

TABLE I.—*Summary of 1947 comparisons*

Date 1947	Time		Calories by water-flow No. 5	Corrected reading of silver-disk S.I. No. 5b1s	Constant of silver-disk S.I. No. 5b1s	Deviation from mean
Aug. 26	10 ^h	56 ^m	1.510	4.154	.3635	+ 11
		11	03	1.502	4.158	.3612
		14	1.512	4.178	.3619	- 7
		22	1.509	4.170	.3619	- 7
		29	1.496	4.155	.3600	- 26
Aug. 27	10	36	1.497	4.149	.3608	- 18
		10	1.520	4.228	.3595	- 31
		17	1.519	4.135	.3674	+ 48
		24	1.531	4.249	.3603	- 23
		31	1.518	4.193	.3620	- 6
	11	42	1.528	4.204	.3635	+ 9
		49	1.525	4.193	.3637	+ 11
		56	1.523	4.186	.3638	+ 12
		04	1.527	4.212	.3625	- 1
		12	1.563	4.267	.3663	+ 37
		19	1.556	4.276	.3639	+ 13
	26	1.538	4.268	.3604	- 22	
	33	1.538	4.217	.3647	+ 21	

Mean, 18 values = .3626

Date 1947	Time		Calories by water-flow No. 5	Corrected reading of S.I. No. 79	Constant of S.I. No. 79	Deviation from mean
Aug. 26	7 ^h	50 ^m	1.373	3.730	.3681	+ 31
		57	1.379	3.754	.3673	+ 23
	8	04	1.393	3.794	.3672	+ 22
	9	37	1.472	4.051	.3634	- 16
		44	1.488	4.044	.3680	+ 30
Aug. 27	7	40	1.380	3.812	.3620	- 30
		47	1.394	3.867	.3605	- 45
		55	1.415	3.852	.3673	+ 23
	8	06	1.428	3.925	.3638	- 12
		13	1.441	3.898	.3697	+ 47
		58	1.470	4.004	.3671	+ 21
	9	05	1.438	3.992	.3602	- 48
		12	1.449	4.011	.3612	- 38
	25	1.451	3.998	.3629	- 21	
	33	1.477	4.028	.3667	+ 17	

Mean, 15 values = .3650

Average deviation, 33 values, .0022.

Probable error, .0003, or .08 percent.

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 110, NUMBER 6

Roebling Fund

MAGNETIC STORMS, SOLAR RADIATION,
AND WASHINGTON TEMPERATURE
DEPARTURES

(WITH TWO PLATES)

BY

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(PUBLICATION 3940)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
JUNE 25, 1948

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

Rochling Fund

MAGNETIC STORMS, SOLAR RADIATION, AND
WASHINGTON TEMPERATURE DEPARTURES

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(WITH TWO PLATES)

Occasionally the earth's magnetic condition is greatly disturbed. At such times large sunspot groups are usually visible near the center of the solar disk. From studies of the aurora, radio transmission, and other electrical phenomena of the atmosphere, it is concluded that the earth is being bombarded by showers of electric ions at times of magnetic storms. These ions appear to emanate most copiously from sunspots.

For many years the Smithsonian Institution has made daily measurements, whenever possible, of the heat equivalent of the energy of solar radiation. It lies mainly in the wave-length region from 0.33 to 2.5 microns (thousandths of a millimeter). This embraces ultraviolet, visible, and infrared rays. The measurements are made in such a way that the losses caused by the earth's atmosphere may be estimated. On each day of observation it is computed what the intensity of the sun's heat would be if one could observe at mean solar distance outside the atmosphere. The values thus obtained are termed measures of "the solar constant of radiation." The average value of the solar constant is about 1.94 calories per square centimeter per minute. Fluctuations in solar-constant values occur, but the range of them is small, seldom exceeding 1 percent of the total.

The earth's atmosphere on a cloudless day diminishes the intensity of solar heat of the direct sun beam reaching the earth's surface in several ways: First, by the scattering exerted by the molecules of oxygen, nitrogen, and other gases of the atmosphere; second, by the scattering and absorption produced by dust particles floating in the atmosphere, and seen as haze; third, by the absorption of rays of certain wave lengths by oxygen, carbon dioxide, water vapor, ozone, and other gases and vapors which produce true absorption of radiation with conversion of radiant energy into heat. About 1880 Lord

Rayleigh proved that the scattering by particles (such as molecules and very small dust particles) which are small compared to the wave length of light is proportional inversely to the fourth power of the wave length. Thus it happens that the sky is blue, because the blue rays, being of shorter wave length than the red or yellow rays, are much more scattered out of the direct sun beam by the molecules of the atmospheric gases.

If now, as stated above, the earth is being showered at times of magnetic storms by multitudes of electric ions, which certainly are small compared to the wave length of light, the direct sun beam, shining 93 million miles through these showers, must be weakened by Rayleigh scattering. The only question is how much. This paper gives the results of an investigation of that question.

Our first experience of such a phenomenon came to us in the year 1920. About March 20 to 23, 1920, there was an enormous sunspot group central on the sun's disk, as shown in plate 1. There was also a severe magnetic storm on the earth, accompanied by fine auroral displays. The storm was most severe on March 22 and March 23. Smithsonian observations of solar radiation made at Calama, Chile, followed the course shown in the upper curve of figure 1. The phenomena of central passage of the great sunspot group included a diminution of the observed values of the solar constant of radiation of the order of 5 percent, reaching the minimum value on March 23. Possibly the very low value of March 23 may have been made unduly low by experimental error, but the value of March 24, nearly as low, is of quite as high a grade as most of the Montezuma values of that year.

Critics may suggest that these low values of the solar constant were caused, not by Rayleigh scattering from electric ions along the 93-million-mile path of sun rays through space, but rather by a hazing of the earth's atmosphere, produced by the adherence of water-vapor molecules to the ions, after they entered the atmosphere; in other words, that the solar-constant values were erroneous. This suggestion, however, runs counter to the observations. For though the lower curve in figure 1, which traces the march of values of atmospheric transmission coefficients for green light at wave length 0.511 micron, does show that the atmosphere became less transparent¹ during the passage of the sunspot through the central position on the sun's disk, that change alone, if it were not countered by other factors in determining the solar constant—factors also affected by atmos-

¹ This change will be accounted for when we consider figure 3 below.

spheric conditions—would have tended to *raise*, not to depress, the solar-constant values. At that time the solar constant was being determined at Calama, Chile, by the fundamental, or "long," method of Langley. The less transparent the atmosphere the greater would have been our estimate of the losses it produced in the solar ray, and the larger the computed solar-constant value outside the atmosphere. But this tendency is counterbalanced exactly by lower observed pyrheliometer readings when the atmosphere is less clear. The solar-

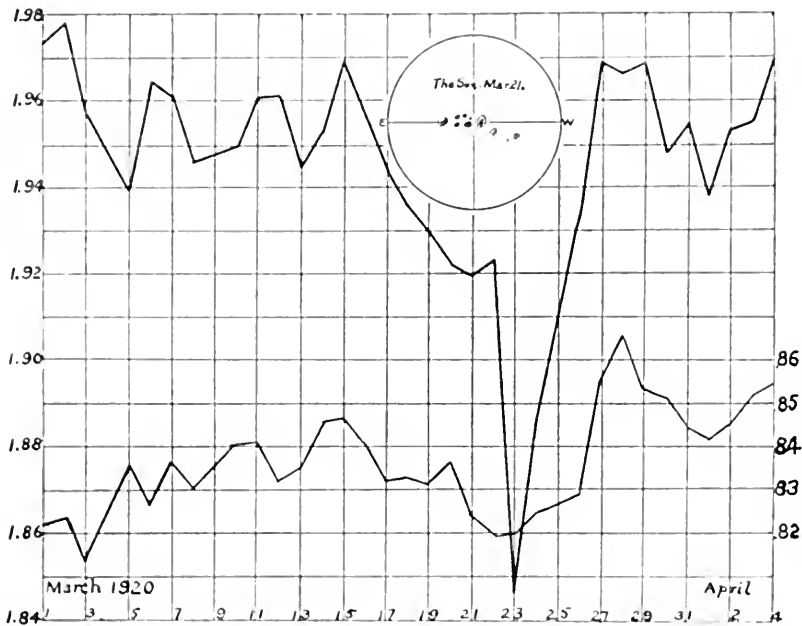


FIG. 1.—Solar constant March-April 1920, upper curve; atmospheric transmission green light, lower curve.

constant values would be too low only if the transparency of the atmosphere was erroneously observed too high.

Other critics have suggested to me that the observed change of the solar constant of March 1920 might have been produced erroneously by a change of the absorption of solar rays by ozone, assuming that the solar outburst of electrified ions produces large changes of the concentration of atmospheric ozone. I reply that all solar-constant values done by the long method, as in 1920, take account of such effects because the atmospheric transmission coefficients are necessarily appropriately modified owing to the method of obtaining them. All solar-constant values done by the short method since 1923 are

specifically corrected for absorption of atmospheric ozone, as explained in volume 5 of *Annals of the Smithsonian Astrophysical Observatory*, pages 124 to 131. Hence this suggestion of critics applies neither to the work of 1920, nor to the work subsequent to 1923.

In conversation with Dr. Nicholson of Mount Wilson Observatory, in September 1947, I asked him if he knew of other occasions when great sunspot groups passed centrally through the sun's disk. If so, I proposed to see if a similar depression of solar-constant values occurred. In reply he suggested that sunspots were "like shot-guns, rather than like rifles," when they pepper space with electric ions. Hence it might well be that *whenever a severe magnetic storm occurs* there will be generated a shower of ions embracing our line of sight and introducing Rayleigh scattering through the 93 million miles of space between the earth and the sun.

MAGNETIC STORMS, 1923 TO 1946

I undertook to test this hypothesis. The phenomena of March 1920, are so exceptional that I omitted them in a general tabulation. From the journal "Terrestrial Magnetism" I found over 70 occasions in the years 1923 to 1946 when very severe magnetic storms were reported. Not being very familiar with the terms used by the observers at the magnetic stations, I am not sure that I found all the dates of severe magnetic storms during this interval. Moreover, the magnetic observers, if they see this paper, may not regard all the storms I selected as severe. There was, indeed, some discrepancy between the estimates of severity from different magnetic stations reporting in "Terrestrial Magnetism." Whatever may be the incompleteness or inexactness of my selection, I feel sure that experts will agree that all the storms included in table 1, which follows, were strong, if not always deserving the description severe.

The magnetic storms continued from 2 to 10 days. It was often uncertain which day to take as representing the height of the storm, that is, the day most likely to be the day when the shower of ions was densest. All the several tabulations of the data which I made showed clearly a depression of the solar constant at or near the height of the magnetic storm. Hence I thought it fair to select as zero day that day during the height of the storm when the solar constant was most depressed.

SOLAR-CONSTANT OBSERVATIONS

Unfortunately I could not use all the storm dates selected. Our observations of the solar constant made at Montezuma and at Mount

St. Katherine are so much more accurate than any others that the results from other stations must be ignored in a study of small changes of this kind. That restriction cuts off a great many dates, because the sequences of solar-constant values, at and near the storm dates, were often too incomplete to be used. With the utmost liberality of selection, I could find but 53 storm dates from 1923 to 1946 when solar-constant sequences observed at Montezuma or St. Katherine were complete enough to be fairly used in the tabulation. Even among those sequences retained, many were so imperfect as hardly to deserve employment. I therefore made two reductions, one employing the whole group of 53 dates, the other employing 22 of them, when the sequences were at least two-thirds complete, and were not broken badly near the zero dates. However, the mean results of the complete tabulation of 53 and the tabulation of the 22 most satisfactory sequences are in almost perfect agreement. Hence it may be said that two independent tabulations, one of 22 cases, the other of 31 cases, yield practically identical results as to the influence of severe magnetic storms on the solar constant.

My solar-constant data, 1923 to 1939, are taken from table 24, volume 6, *Annals of the Astrophysical Observatory of the Smithsonian Institution*. From unpublished daily results, those of 1939 to 1946 were kindly put at my disposal by Director L. B. Aldrich of the Observatory. In quoting from the *Annals* I have used the direct mean values from Montezuma or St. Katherine, and not the "preferred" values. I have come to distrust the method used to obtain "preferred" values, and it has not been used in the reductions of 1939 to 1946. Furthermore I have ignored "grades." They are more or less liable to personal bias, and especially to a tendency to discredit apparently wild values. It is very clear from the present research, and from another I have made on hurricanes, that some wild values are caused by cosmic conditions, not by errors of observation.

EFFECT OF MAGNETIC STORMS ON THE SOLAR CONSTANT

With these explanations given, I now ask attention to table 1. It enumerates the 53 dates retained.² Corresponding to each one is a sequence, more or less complete, of solar-constant values from Montezuma or Mount St. Katherine. It extends from 10 days before to 10 days after the date marked zero, when the magnetic storm appeared to be at its height. The table has 53 more or less complete lines of 21

² The phenomenon of March 22, 1920, is of so much greater range of severity that I have treated it separately above, and do not include it in table 1.

columns. Two additional lines give the number of values per column and their mean values. To save printing, the first two places of the solar constant are omitted. The reader must therefore remember that where, for instance, "32" is printed, 1.932 is to be understood.

Although, as stated above, about 20 storm dates had been omitted, because the corresponding sequences of solar-constant values were too

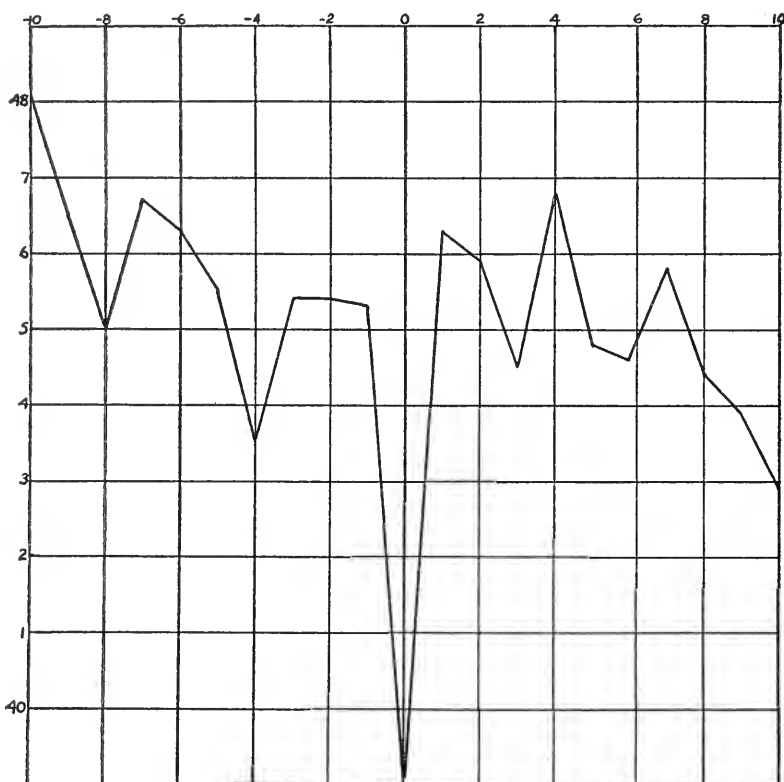


FIG. 2.—Depression of solar constant attending severe magnetic storms. Abscissae, days before and after height of storm; ordinates, solar constant (to be prefixed by 1.9).

defective, there still remain many very incomplete sequences in the table. I therefore thought it good, as I have said, to pick out a smaller number of occasions when the sequences, especially those near zero day, were nearly full. These selected dates, 22 in number, are indicated by asterisks in the table. Their mean values and the numbers of observations entering into these means, are given in the last lines of table I.

as between the means of the first 9 and the last 9 of the solar-constant values of the sequences.

In order to illustrate the variation in effect of magnetic storms on solar radiation depending on the magnitude of sunspots and their location on the sun's disk, I ask the reader to compare plate 2 with plate 1. Plate 2 includes direct photographs of the sun taken at Mount Wilson on November 28, 1936, and February 3, 1937. On these dates there was no central sunspot group, as on March 22, 1920. On November 28, 1936, two large sunspot groups were at about 20° solar latitude both north and south of the center of the sun's disk and another near the sun's limb. On February 3, 1937, there were many small spot groups upon the disk, and one very large one near the sun's limb, but none near the center of the disk. Accordingly we see from the solar-constant records a very large depression in March 1920 (see fig. 1), a conspicuous depression in November 1936, and scarcely any depression in February 1937 (see table 1), at the times of severe magnetic storms.

MAGNETIC STORMS AND SKY CONDITIONS

Thus the magnitude of the Rayleigh depression of solar radiation resulting from 93 million miles of ionic shower proves measurable. Since these ions invade the earth's atmosphere, we may look for two meteorological effects. First, the captured ions are likely to act as centers of condensation of water molecules and dust, and thereby increase the haziness and the brightness of the sky. Second, the surface temperatures of the earth might be affected.

From table 24, *Annals*, volume 6, and unpublished later records, I collected for 30 magnetic-storm dates the pyranometer measures at air mass 2.5 of the brightness of the sky near the sun. The mean values for these dates and the 10 days before and 10 days after, together with the numbers of observations entering into each mean, are given in table 2 and graphically in figure 3.

It appears that the haziness of the sky increased suddenly on the storm day,³ and sky brightness near the sun averaged 10 percent higher for the 10 last days of the sequences than for the first 10 days. As could be expected, the graph, figure 3, is rather irregular. It must be considered that the principal causes of sky haziness lie in the lower layers of the atmosphere, and are subject to great fluctuations as dust and humidity float about in the changing air currents. Hence the

³ This tends to explain the drop in atmospheric transparency shown in figure 1.

relatively minor effects of the invasion of ions, at times of magnetic storms, are superposed on large variations of sky brightness due to other causes.

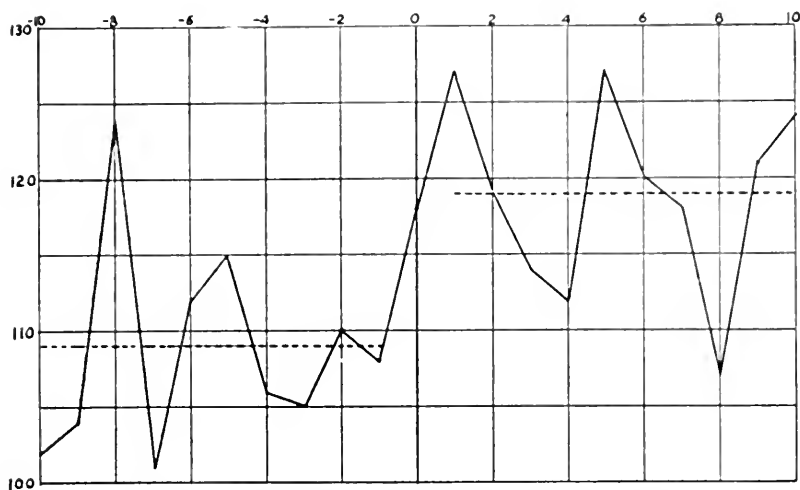


FIG. 3.—Increased sky brightness after severe magnetic storms. Abscissae, days before and after height of storm; ordinates, pyranometer observations of sky brightness.

TABLE 2.—Effect of magnetic storms on sky brightness. Pyranometer observations

Days from zero day.....	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	
No. of observations.....	10	19	19	21	24	21	19	24	23	23	23	22	19	24	22	23	23	19	19	21	19	
Mean pyranometer	102	104	124	101	112	115	106	105	110	108	118	127	119	114	112	127	120	118	107	121	124	
	Mean of first 10 = 109											Mean of last 10 = 119										

MAGNETIC STORMS AND WASHINGTON TEMPERATURE

It remains to trace the effects of ionic bombardment on temperature at the earth's surface. The departures from normal temperatures at Washington from 9 days before zeroth day to 9 days after have been tabulated for 73 severe magnetic storms occurring from 1923 to 1946. In this tabulation no vacancies occurred in the sequences. Hence I give only the mean results in table 3 and figure 4.

Washington temperature fell sharply, beginning 1 day before the magnetic storm, and reaching a level on storm day 3° below that of the mean of temperatures from 9 to 2 days before the storm. After the storm the temperature rose sharply, but averaged 0.8° lower from the second to the ninth day after the storm than the mean value before it.

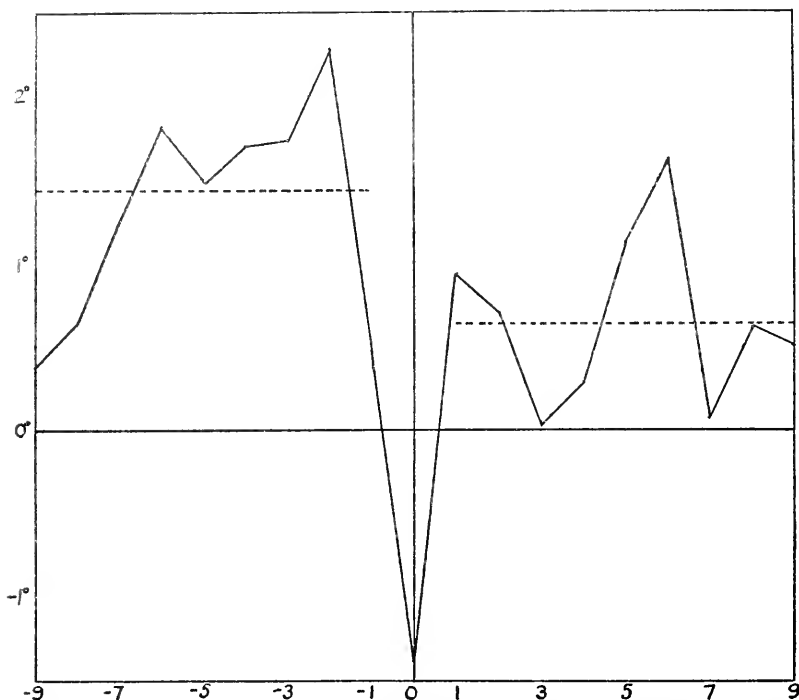


FIG. 4.—Washington temperatures depressed by severe magnetic storms. Abscissae, days before and after height of storm; ordinates, degrees centigrade of departures from normal.

TABLE 3.—Effect of magnetic storms on Washington temperature

Days from zero day.	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8
Mean departure from normal temperature.	0°.37	0°.63	1°.25	1°.81	1°.48	1°.70	1°.74	2°.28	0°.47	-1°.38	0°.93	0°.70	0°.04	0°.29	1°.12	1°.60	0°.07	0°.61
	Mean of first 8 = 1°.41									Mean of last 8 = 0°.64								

OTHER CASES OF TEMPERATURE CHANGE CAUSED BY VARIATION OF SOLAR RADIATION

Simpson, in his classical investigation of the temperature of the earth's atmosphere, and its relation to radiation, computed the theoretical effect of a rise of 1 percent in the solar constant. For eastern North America he found that such a rise in radiation would depress temperatures at the earth's surface. Clayton, by statistical studies of actual changes in solar radiation to temperature, had also arrived at the same result. Indeed his isothermal lines, corresponding to a rise of 1 percent in the solar constant, very nearly map out the extension of Pleistocene glaciation in North America. See, for instance, figure 21, Smithsonian Miscellaneous Collections, volume 77, No. 6, 1925.

As stated above, I find the opposite trend in temperature at Washington to that found by Simpson and Clayton. For I find a depression of temperature following a sudden obscuration of the planet earth, caused by its bombardment by electric ions. The circumstances, however, are not parallel. Those authors treated of a relatively permanent increase of solar radiation. The larger part of the range of the magnetic storm effect is very short-lived, less than 2 days. Moreover, there is no change of atmospheric transparency to be assumed in the investigations of Simpson and Clayton, except as increased earth temperature presently gives rise to increased atmospheric humidity and greater cloudiness. The magnetic storm, on the contrary, immediately diminishes atmospheric transparency. Any change of cloudiness, which might eventually follow, would doubtless be delayed more than the 9 days after the storm covered by my tabulation. So it seems to me there is no unexplained contradiction between these results and those of Simpson and Clayton.

NUMBER OF IONS IN A SHOWER

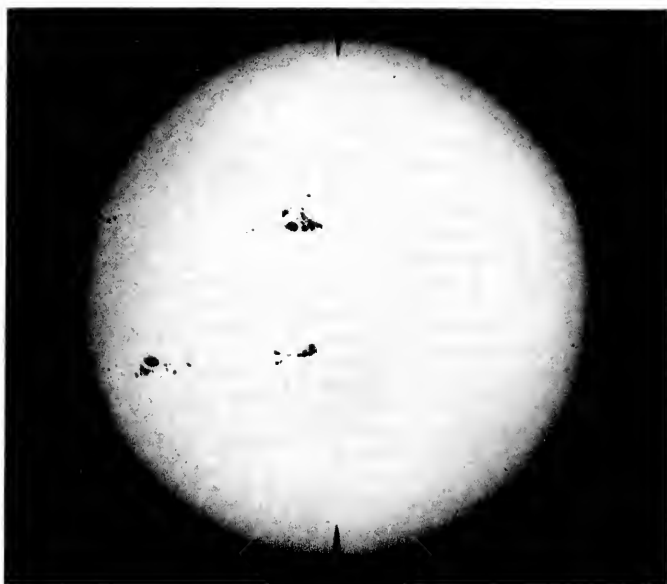
One other point of some interest is an inquiry as to the average density of the shower of electric ions for the 53 cases of severe magnetic storms covered by table 1. The effect produced was to diminish the solar constant by $\frac{1}{3}$ percent. Referring to Annals, volume 6, figure 11, page 166, the center of gravity of a solar-constant change associated with Rayleigh scattering may be set at about wave length 0.40 micron. On very clear days above Montezuma, with air mass 1.0, the solar radiation may be observed as high as 1.65 calories per square centimeter per minute, or $\frac{0.29}{1.94} = 15$ percent lower than the solar constant. If readers think it worth while, they may compute from Rayleigh's equations, and the above data, the numbers of particles involved under the two sets of circumstances. But roughly estimating, one might say that the 93 million miles of space contained $\frac{0.34}{15} = 0.023$ as many particles as would be contained of molecules in the atmosphere above Montezuma, where the barometric pressure is about 590 mm. mercury. These figures relate, however, to cases when the great sunspot groups were not central on the sun's disk. The great group of March 1920, produced about 10 times as great an effect on the solar constant as the average of the 53 cases of 1923 to 1946.

Using Humphrey's estimate of atmospheric densities, Millikan's

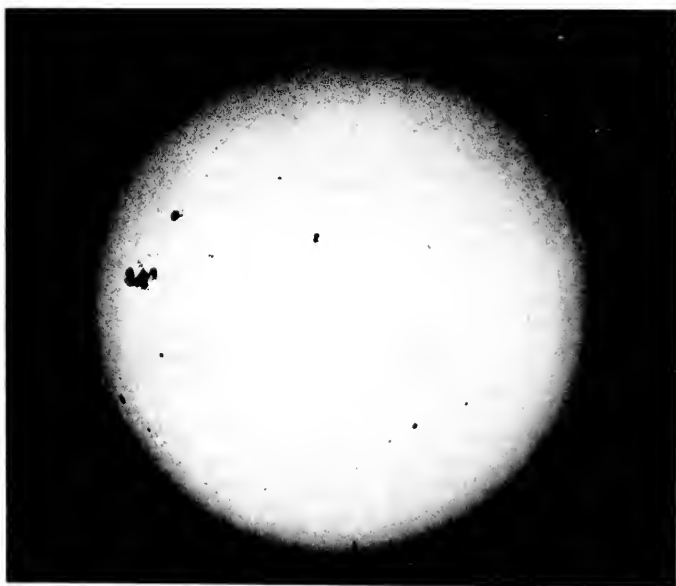
figure for the number of molecules per cubic centimeter at sea level, I compute that the number of molecules in a column of air of 1 square centimeter cross section above Montezuma is approximately 1.4×10^{25} . If there are 0.023 times as many ions in the ionic showers accompanying average severe magnetic storms, it follows that the average increase of density in ions per cubic centimeter in space between the earth and the sun on such occasions is $\frac{1.4 \times 10^{25} \times 0.023}{15 \times 10^{12}} = 2 \times 10^{10}$, or 10 times the number of the earth's inhabitants, approximately. On March 23, 1920, the figure was approximately 10 times larger still.



SOLAR PHOTOGRAPH MARCH 20, 1920 (MT. WILSON)



1. SOLAR PHOTOGRAPH, NOVEMBER 28, 1936 (MT. WILSON)



2. SOLAR PHOTOGRAPH, FEBRUARY 3, 1937 (MT. WILSON)

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 110, NUMBER 7

GUSTAVUS SOHON'S PORTRAITS OF
FLATHEAD AND PEND D'OREILLE
INDIANS, 1854

(WITH 22 PLATES)

BY

JOHN C. EWERS

Associate Curator of Ethnology
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(PUBLICATION 3941)

CITY OF WASHINGTON
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G. Sohon

G. SOHON

Portrait taken in 1863. Courtesy of Dr. Elizabeth Sohon.

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GUSTAVUS SOHON, ARTIST, LINGUIST, AND EXPLORER

The Flathead and Pend d'Oreille Indians, who lived in the mountain valleys of what is now the western part of the State of Montana and crossed the Continental Divide of the Rocky Mountains to hunt buffalo on the open plains, were not portrayed in the drawings and paintings of famous American and European artists who visited the Upper Missouri region in pre-reservation days. However, a private soldier in the United States Army, who was well acquainted with the Flathead and Pend d'Oreille tribes in the middle of the nineteenth century, has left a pictorial record worthy of these remarkable Indians in a series of realistic pencil portraits of his Indian friends. These portraits are signed "G. Sohon."

Gustavus Sohon was born in Tilsit, Germany, December 10, 1825. His daughter, Dr. Elizabeth Sohon, recalled that he used to speak of having attended "University," and Hazard Stevens, who knew him in 1855, called him "well-educated." When he came to America at the age of 17, to avoid compulsory service in the Prussian Army, which was distasteful to him, he spoke English, French, and German fluently. Whether Sohon ever had any formal instruction in art is not known.

Little is known of his life in Brooklyn during the decade following his arrival in this country. His daughter understood that he had made some woodcarvings for sale, and a son, the late Henry W. Sohon, wrote that "he engaged in the photograph business." However, upon his enlistment, he gave his occupation as "bookbinder."

Gustavus Sohon enlisted as a private in the United States Army in New York City, July 2, 1852, at the age of 26. Routine Army records describe him at that time as dark-complexioned, hazel-eyed,

black-haired, 5 feet 7 inches tall. He was assigned to Company K, Fourth Infantry Regiment. A few days later his Company was ordered to board the steamship *Golden West* for service on the Pacific Coast. After a brief stop at Benicia, Calif., Headquarters of the Military Department of the Pacific, Company K was ordered to the frontier military post of Fort Dalles on the Columbia River in Oregon Territory. The men arrived at Fort Dalles in September 1852.

Sohon went west at a momentous period in the development of the Western United States. For several years there had been a Nation-wide demand for a railroad to connect the growing settlements of the Pacific slope with the eastern States. However, strong rivalry existed in the East regarding the location of the route, and the choice of its eastern terminus. In 1853 Congress authorized the War Department "to ascertain the most practicable and economical route for a railroad from the Mississippi River to the Pacific Ocean." Three surveying expeditions were organized to explore a northern, a central, and a southern route. Governor Isaac I. Stevens of Washington Territory was placed in charge of the project to explore the northern route between the forty-seventh and forty-ninth parallels from the Mississippi River to Puget Sound.

Governor Stevens left St. Paul in early June, 1853, at the head of an exploring and surveying party moving westward across the plains to meet a second party, surveying eastward from the Pacific under his assistant, Capt. George B. McClellan. Stevens also ordered Lt. Rufus Saxton, Jr., acting assistant quartermaster and commissary of the expedition, to proceed eastward from the Pacific side and establish a depot of provisions at the Flathead Indian village of St. Mary's west of the Rockies. Lieutenant Saxton, with an escort of 18 soldiers from the Fourth Infantry, left Fort Dalles with the supply train on July 18, 1853. Gustavus Sohon was one of the enlisted men assigned to duty with this party. They traveled eastward via the Columbia River, Lewis' Fork, Clark's Fork, Flathead Lake, and up the Bitterroot Valley to St. Mary's village on the Bitterroot, then known as the St. Mary's River. En route this caravan met a party of about 100 Pend d'Oreille Indians returning from a buffalo hunt on the plains east of the Rockies with a large supply of buffalo robes and dried meat, which they planned to trade to the Indians nearer the west coast. It was Sohon's first glimpse of some of the mountain Indians whom he was later to know well.

Saxton's party also met the two Messrs. Owen, who had purchased the property of the Jesuit Mission of St. Mary's in 1850 and estab-

lished Fort Owen, a trading post, on its site. Because of continued hostile raids by Blackfoot Indians from east of the mountains, they had decided the location was no longer safe, and were on their way to the Pacific Coast. Upon seeing Saxton's armed force, they were encouraged to return to their abandoned post. Saxton's party reached Fort Owen on August 28. They found it surrounded by a considerable village of log cabins. They were surprised to find cattle, chickens, and growing crops of wheat and potatoes tended by Iroquois Indians. The Flathead Indians were absent on a buffalo hunt across the mountains.

By fall Governor Stevens was convinced that the critical problem confronting his survey was that of determining the most practical and economical route for the railway over the Rocky and Bitterroot ranges of mountains. Although the mountain region had been known to fur traders for several decades, the only mathematical data and maps available were those compiled by the explorers Lewis and Clark in their hasty travels through the area a half century earlier. There was need for more detailed scientific information. Accordingly, Stevens decided to leave a small party in the Bitterroot Valley through the winter of 1853-54 to make precise meteorological observations and to explore and survey the country between the Rocky and Bitterroot Mountains from Fort Hall northward to Flathead Lake and beyond, with particular emphasis upon the examination of the entrances to the mountain passes. On October 3, 1853, Stevens ordered Lt. John Mullan to take charge of these important investigations, and assigned 15 men to Mullan's command. Gustavus Sohon was one of this little group.

Mullan proceeded to erect a group of rude log huts 14 miles south of Fort Owen on the Bitterroot River. This little settlement, named Cantonment Stevens, served as a weather station, winter quarters, and headquarters for the party's explorations of the intermountain region.

Gustavus Sohon's services to Lieutenant Mullan in his explorations of 1853-54 were invaluable. A gifted linguist, Sohon learned to speak the Salishan languages of the Flathead and Pend d'Oreille Indians with remarkable rapidity. He became Lieutenant Mullan's interpreter and aided him in gathering important information from the Indians on the trails, mountain passes, and general geography of the region. It was probably during this period that Sohon began the compilation of the Flathead-English vocabulary which is now in the manuscript collections of the Bureau of American Ethnology. It includes some 1,500 useful words and phrases.

Sohon also accompanied Mullan on his extensive explorations of the intermountain region from Fort Hall on Snake River in the south to the Kootenay River on the north. They crossed the Continental Divide six times and measured the snowfall in the passes. Sohon made a series of excellent landscape sketches depicting the character of the country traversed, important landmarks, Cantonment Stevens, and views of the party on the march which were valuable as a record of the explorations.

In spring and early summer Sohon drew the remarkable series of pencil portraits from life of the chiefs and headmen of the Flathead and Pend d'Oreille tribes which is the subject of this paper. The dated Pend d'Oreille portraits of April 21 to May 1 were drawn in the Flathead Lake-Kootenay River region during Lieutenant Mullan's northern explorations in the spring of 1854. The portraits of Flathead and Iroquois living with that tribe, dated May 12 to June, 1854, probably were drawn in the vicinity of the Flathead village at Fort Owen in the Bitterroot Valley.

Doubtless Sohon rendered valuable service also as map maker and barometrical observer. If Sohon had had little experience in this work before, it is certain that he learned quickly. After a year of field work in the mountain valleys, Lieutenant Mullan led his little party westward to make his report to Governor Stevens. They arrived at Fort Dalles on October 14, 1854.

Governor Stevens was so favorably impressed with the work of Gustavus Sohon while under Lieutenant Mullan's command that he made a special request to Major General Wool, Commander of the Military Department of the Pacific, to have Sohon transferred to his command. On March 31, 1855, by authority of Major General Wool, Private Sohon was ordered to detached duty with Governor Stevens' expedition.

In the spring of 1855, before setting out on an important expedition to obtain additional detailed information for the railway survey and to make the first treaties between the United States and the Indian tribes of the Upper Columbia River and Northwestern Plains regions, Governor Stevens paid tribute to Private Sohon:

I also secured the services of a very intelligent, faithful, and appreciative man, Gustavus Sohon, a private of the Fourth Infantry, who was with Mr. Mullan the year previous in the Bitter Root valley, and had shown great taste as an artist, and ability to learn the Indian language, as well as facility in intercourse with the Indians. . . . Thus in the month of May, 1855, I found myself in the Walla-Walla valley, and with the means, by proper care and management of time, and a little hard work, to make a good examination of the country. My secretary, James Doty, esq., assisted me in the topography, and G. Sohon,

Nez Percé Indians preparing the records of the Walla Walla
Council. June 1855



NEZ PERCÉ INDIANS PREPARING THE RECORDS OF THE WALLA WALLA COUNCIL. JUNE 1855

made the barometrical observations. [Report of Explorations, etc., 1860, vol. 12, pt. 1, p. 196.]

Governor Stevens' son, who accompanied the expedition, wrote of Sohon as "the artist, barometer-carrier, and observer . . . an intelligent German, a clever sketcher, and competent to take instrumental observations." (Stevens, 1900, vol. 2, p. 68.)

In one of the largest gatherings of Indians in historic times, Governor Stevens and General Palmer, as United States Commissioners, met the Walla Walla, Cayuse, Umatilla, Yakima, and Nez Percé tribes of the Upper Columbia in late May and early June, 1855. This "Walla Walla Council" was held on Mill Creek, a tributary of the Walla Walla River, about 6 miles above the site of the ill-fated Whitman Indian Mission. The negotiations resulted in the cession to the United States of over 60,000 square miles of land, and the setting aside of three reservations for the Indians involved, one for the Walla Walla, Cayuse, and Umatilla, one for the "Yakima Nation," and one for the Nez Percé. The three separate treaties were signed June 9.

Although Sohon did not serve as an official interpreter at this Council, he apparently helped to interpret the proceedings to a group of Salishan-speaking Spokane Indians who attended the sessions. His "Records of the Walla Walla Council 30th May 1855, translated in the language of the Spokane Indians by G. Sohon," a manuscript in the collections of the Bureau of American Ethnology, is a parallel English-Spokane text of the opening speech at the Council by General Palmer.

Sohon's pencil was active during the period of the Walla Walla Council. He sketched the impressive parade of some 2,500 Nez Percé Indians arriving at the Council ground on horseback May 24, the feast given the chiefs by the Commissioners on the following day, a general view of the Council in session, and the primitive scalp dance celebrated by the Nez Percé on the day after the treaties were signed. He also made pencil portraits of the principal chiefs of the tribes that took part in the treaties. (The previously published drawings of Gustavus Sohon at the Walla Walla Council are listed in the Appendix, p. 68.) A remarkable aspect of this Council was the recording of the proceedings in the Nez Percé language by a group of young men who had been taught to read and write their own language by Presbyterian missionaries. Sohon's previously unpublished drawing of these Indian scribes at work appears as plate 1.

From the Walla Walla Council ground Governor Stevens' party of 22 persons, including 2 Indian guides, moved eastward. At a council

ground on the east bank of the Missoula River, $7\frac{1}{2}$ miles northwest of the present city of Missoula, Mont., Governor Stevens met the leaders of the Flathead, Upper Pend d'Oreille, and Kutenai tribes. The Council opened July 9 and ended July 16 in the signing of a treaty between these tribes and the United States which provided for the cession of some 25,000 square miles of Indian land. Details of this complex treaty are discussed in later pages of this paper.

Gustavus Sohon and Ben Kiser, a half-breed Shawnee who lived with the Flathead, served as the official interpreters at this Flathead Treaty Council. The Flathead Indians still refer to the treaty site as "where the trees have no lower limbs." Sohon's sketch of the Council in session (pl. 2), the only pictorial record of the event, shows this characteristic of the locality.

From this council ground the Stevens party continued eastward to make a treaty with the Blackfoot Indians and their neighbors. En route Sohon assisted Governor Stevens in making an examination of the approaches to Cadotte's Pass over the Rockies, drew panoramic sketches of the Rocky Mountain chain as seen from the plains on the east, and took numerous barometrical observations.

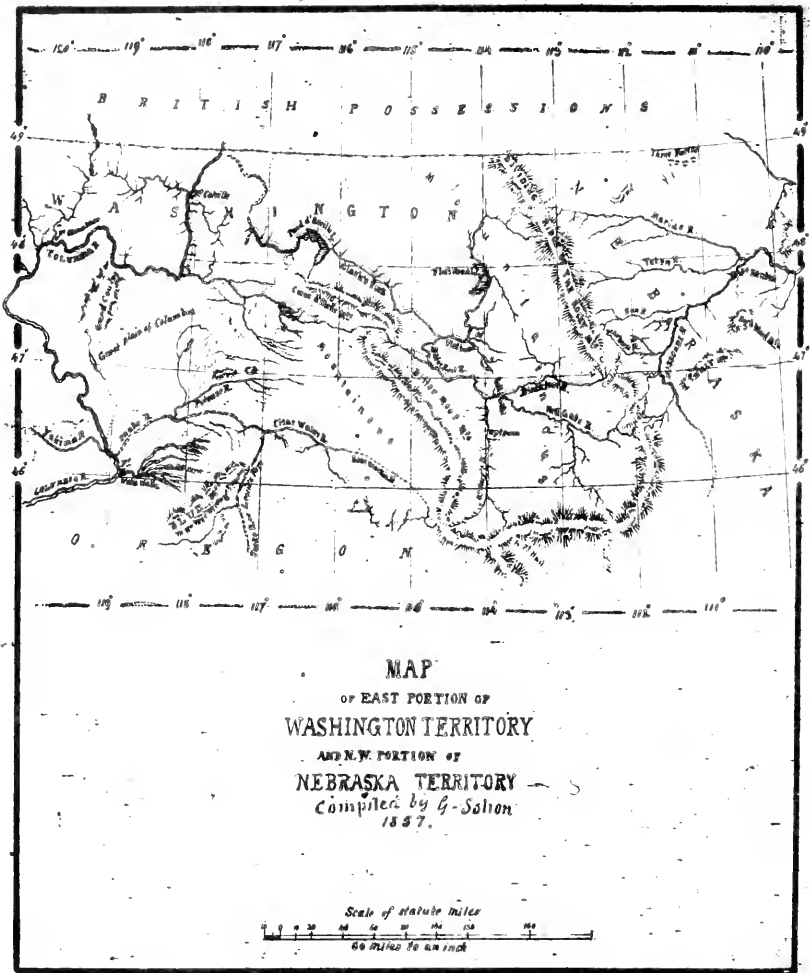
On October 16 Governor Stevens and Alfred Cumming, as United States Commissioners, met the chiefs of the three Blackfoot tribes, and the Gros Ventres, Nez Percé, Flathead, and Upper Pend d'Oreille, at a council ground near the mouth of the Judith River in the present State of Montana. Next day a treaty was signed. The treaty provided for no Indian land cessions, but it did define the boundaries of the hunting grounds of the Blackfoot tribes and of the Indian tribes from west of the Rockies who hunted buffalo on the plains.

Gustavus Sohon and Ben Kiser served as official Flathead interpreters. Sohon also made a sketch of the Council in session and a series of fine pencil portraits of both the white officials and the leading chiefs of the Blackfoot tribes who signed this first treaty between the United States and the Blackfoot. (See Appendix, p. 68, for list of published drawings made by Sohon at the Blackfoot Council.)

Governor Stevens intended to make treaties with the Spokane, Colville, and Coeur d'Alene tribes during his return journey to the west coast. However, on October 29, the day after his party left the council ground, he was met by a mounted courier from the west bearing the alarming report that some of the tribes with whom he had recently treated at Walla Walla had broken out in open war. The dispatches warned Stevens not to attempt to return through the country of the hostile Indians, but he obtained additional arms and



THE FLATHEAD TREATY COUNCIL, JULY 1855



Note all that east of the Rocky Mtn. Range which is now Montana did then belong to Nebraska

COUNTRY BETWEEN FORT BENTON ON THE MISSOURI AND
FORT WALLA WALLA ON THE COLUMBIA
Sketch map by Gustavus Sohn, 1857.

ammunition from Fort Benton and pressed on as quickly and as quietly as possible. The party crossed the Coeur d'Alene range of mountains in deep snow in late November, passed through the country of the hostiles, and reached Fort Dalles safely by the end of the year 1855.

Private Sohon remained on detached duty under Governor Stevens' command until April of 1856. During that period he may have worked over his sketches and assisted in the preparation of maps and meteorological data obtained in the previous years. When Governor Stevens' reports of his explorations and surveys of the northern railway route were published in 1860, the greater part of the colored lithographs used as illustrations were reproduced from original drawings by John Mix Stanley, the official artist of the expedition, who returned east in 1854. However, this publication also contains 10 illustrations after Gustavus Sohon's sketches, and 2 others redrawn by Stanley from Sohon's original work. The Sohon illustrations were a portion of those made during his service under Lieutenant Mullan in the valley in 1853-54, and with Governor Stevens' treaty-making expedition of 1855. (They are listed in the Appendix, p. 67.)

On April 19, 1856, Private Sohon was ordered to detached duty at Fort Steilacooms, Washington Territory. Six months later he was transferred to duty in the office of Captain Cram, of the Topographical Engineers, at the Headquarters of the Department of the Pacific, Benicia, Calif., where he served as a draughtsman in the preparation of maps of the western portion of the United States for the remainder of his period of military service. Private Sohon was honorably discharged from the Army at the expiration of his 5-year enlistment, at Fort Walla Walla, July 2, 1857.

The small-scale map, reproduced as plate 3, was drawn on tracing cloth by Gustavus Sohon in 1857. Although its original purpose is not known, it serves to indicate the knowledge of the country between Fort Benton on the Missouri River and Fort Walla Walla on the Columbia at that time. It also portrays the area in which Sohon traveled and made extensive detailed explorations and surveys during the decade 1853-62.

In March 1854 Lieutenant Mullan had been successful in taking a wagon train over the Rockies by way of Mullan Pass from Fort Benton to the Bitterroot Valley. Thus he suggested the possibility of a wagon road over the Northern Rockies. In 1855 Congress appropriated \$30,000 for the construction of a military wagon road

across the mountains from Fort Benton to Fort Walla Walla. Continued Indian unrest in the Northwest prevented work on the project. In 1858 Isaac I. Stevens was influential in obtaining an additional Congressional appropriation for this work and in the assignment of Lt. John Mullan to the position of officer in charge of the project.

Lieutenant Mullan organized a party to explore and survey the route at The Dalles, May 15, 1858. He employed Gustavus Sohon as civilian "Guide and Interpreter" to the party. They had moved eastward but a few miles when Lieutenant Mullan received word of the defeat of Colonel Steptoe's force by Spokane Indians on the Pelouse River, directly in the path of Mullan's proposed route. Realizing the impossibility of continuing the road survey, Lieutenant Mullan returned to The Dalles and disbanded his party with the exception of topographer Kolecki, guide Sohon, and a few men to care for his stock. He then offered the services of the remainder of his party to General Clarke, who assigned Mullan to the staff of Colonel Wright as topographical officer. Lieutenant Mullan also commanded the group of 33 loyal Nez Percé Indian guides and scouts attached to Colonel Wright's command. Wright marched against the hostile Indians at the head of a force of 680 soldiers. In the two battles of Four Lakes on September 1 and Spokane Plains on September 5 he decisively defeated the enemy force of Coeur d'Alene, Spokane, and Pelouse Indians.

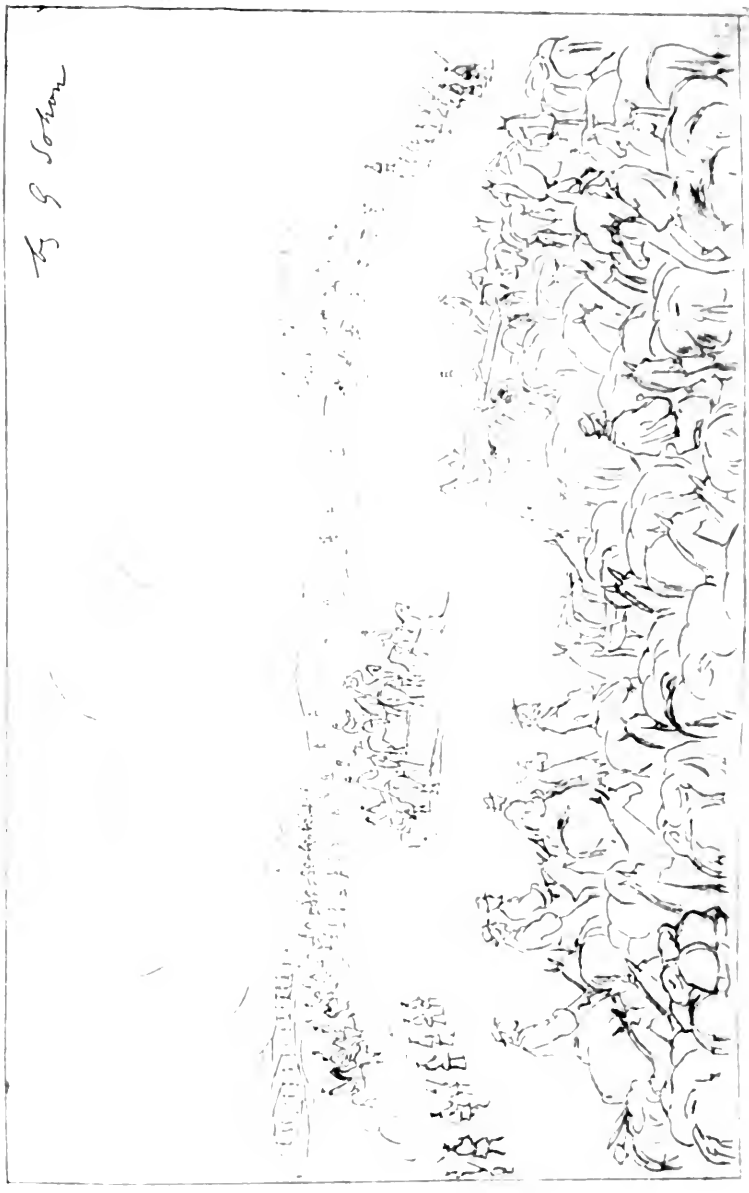
Sohon made a sketch of the Battle of Spokane Plains on September 5, 1858 (pl. 4). It portrays the essential character of the battle. The retreating Indians had set fire to the prairie grass and under cover of the smoke, surrounded the soldiers on three sides. Colonel Wright promptly ordered the pack train to close up and surrounded it with a line of fighting men. The soldiers possessed improved long-range rifles which they used with deadly effect to beat back the sporadic attacks of the Indians who were armed only with short-range Hudson's Bay muskets, bows and arrows, and lances.

Mullan's men remained with Colonel Wright through the three peace councils with the hostiles in late September. Later Lieutenant Mullan returned to Washington to obtain further appropriations for the wagon road project.

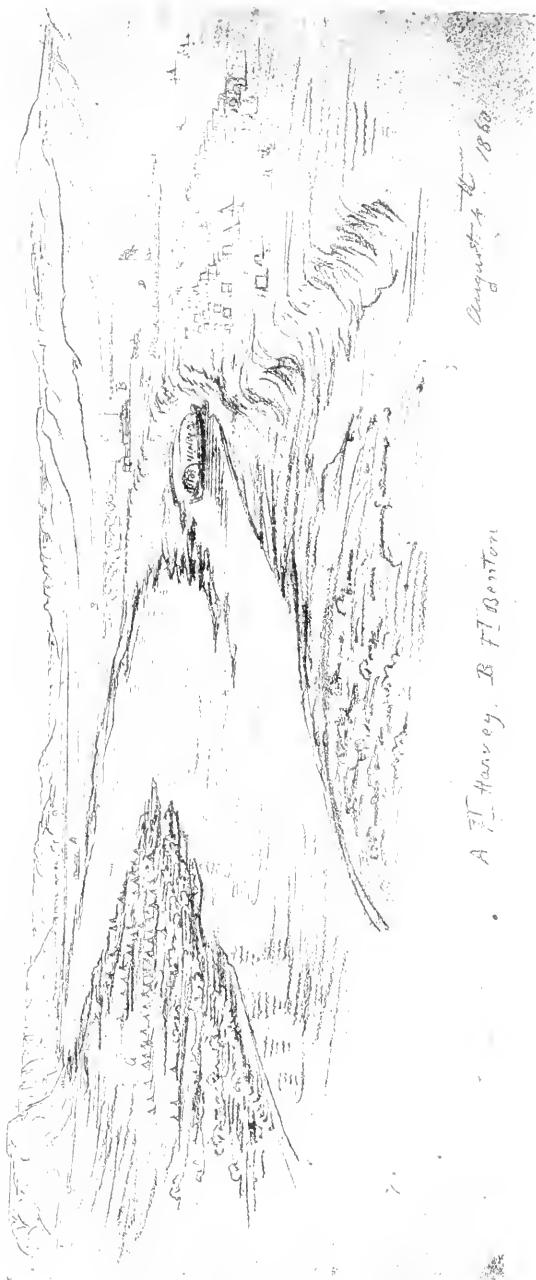
In May 1859 Lieutenant Mullan again organized his party at The Dalles. In June he ordered Sohon to move forward in search of a possible route across the Bitterroot Mountains south of the Coeur d'Alene River—St. Regis Borgia River crossing. In his published

Battle on the Spokan plain - led by Wright in command and against
Cannibal forces of the Indians, 1858.

T. S. Johnston



BATTLE ON THE SPOKAN PLAIN



FORT BENTON ON THE UPPER MISSOURI
(Fort Harvey in background.) August 4, 1860.

report Mullan explained his choice of Sohon for this important mission:

Mr. Sohon's early connexion with my explorations in 1853 and 1854, his knowledge of the Indian language, his familiarity with the general scope of the country to be traversed, and the influence he had always so beneficially exerted over the Indians, all pointed him out as the proper person to explore the new and dangerous route. [Mullan, 1863, p. 11.]

Sohon found the Coeur d'Alene unwilling to furnish guides for the exploration of the mountain area south of the Coeur d'Alene River, and strongly opposed to the location of a wagon road in that region. He returned to Mullan's camp July 7, after an absence of more than a month alone in the country of Indians who, if not in open war, were still unfriendly to whites.

Abandoning hope of crossing to the south, Mullan pushed the road survey forward vigorously via the Coeur d'Alene Mission, and Coeur d'Alene River—St. Regis Borgia River crossing of the mountains, and down the valley of the St. Regis Borgia. Sohon, in charge of the small advance party, marked out the route and determined the location of the mountain pass over the Coeur d'Alene to be followed by the wagon road. The party wintered in a group of log huts on the St. Regis Borgia River, which they called Cantonment Jordan.

On July 1, 1860, while working in the area immediately west of the Rockies, Lieutenant Mullan received word that Major Blake with a command of 300 recruits en route to Fort Walla Walla had arrived at Fort Benton by steamboat and awaited Mullan's arrival for guidance over the mountains by the new road. Gustavus Sohon was transferred to Major Blake as guide and interpreter for his command. But before leaving Fort Benton, Sohon made a quick pencil sketch of the locality as seen from the east. The wagons in the right foreground probably are those used by Major Blake in crossing the mountains (pl. 5).

Gustavus Sohon guided the first wagon party to cross the mountains from Fort Benton to Fort Walla Walla, the first wagons to reach the Columbia River from east of the Continental Divide by a route north of the South Pass, in the present State of Wyoming. Major Blake's party left Fort Benton August 7, 1860, and arrived at Fort Walla Walla without mishap on October 4, spending 48 days in traveling and 11 resting along the way. This successful journey, which was made possible by Sohon's experienced guidance, convinced Lieutenant Mullan of the practicality of the wagon road.

Lieutenant Mullan and Sohon were again in the field in 1861. Starting once more from Walla Walla, they made extensive improve-

ments in the road, laying out new sections over better terrain or shortening the distances to be traveled, decreasing the number of necessary river crossings. When a new section of road was to be laid out, Sohon moved ahead with a small party to mark out the road and make detailed observations on the features of the country. The party wintered at Cantonment Wright at the junction of the Hell Gate and Big Blackfoot Rivers. In June 1862 Sohon was in charge of the main party which followed Lieutenant Mullan's advance party west. Lieutenant Mullan disbanded his expedition at Walla Walla in late August, 1862.

After more than 4 years of work, the wagon road was completed. It was the first road to connect the head of navigation on the Missouri with the head of navigation on the Columbia. Some 624 miles long, and from 25 to 30 feet wide, it could be traveled by lumbering wagons in 57 days, by pack animals in 35 days. Although originally intended as a military road to transport men and supplies to the posts of the far northwest, it was used primarily as a highway for travelers and settlers, and for the transport of freight to and from the northwest. "The Mullan Road," as it was commonly called, rendered important service to the settlement of the far northwest in the days before the railroads reached that section.

Mr. Sohon journeyed to Washington with Captain Mullan after the field season of 1862. In Washington he probably assisted Mullan in the preparation of data, maps, and illustrations for his official report on the project. The "Report on the Construction of a Military Road from Fort Walla Walla to Fort Benton" was published in 1863. It is illustrated by 10 colored lithographic reproductions of original drawings by Gustavus Sohon, all of which are erroneously labeled "C. Sohon." (A list of these illustrations appears in the Appendix, pp. 67-68.) Three of the large folding maps at the end of this report credit Gustavus Sohon as one of the civil engineers who contributed material to their compilation. On the two maps which show the location of the pass between the Coeur d'Alene and St. Regis Borgia Rivers, the name "Sohon Pass" is given to the location. Lieutenant Mullan named the pass in honor of Gustavus Sohon who made the first topographical map of it. Father De Smet crossed this pass in 1863, and referred to it as "Sohon Pass." (Chittenden and Richardson, 1905, vol. 3, p. 795.) However, when the railway was built over the Coeur d'Alene Mountains in 1889, it crossed the summit by another pass of nearly equal altitude, $1\frac{1}{2}$ miles northeast of Sohon Pass. The name Lookout Pass is now applied to the one followed by both the

railway and Highway No. 10 over the Coeur d'Alenes. During the 1890's the name St. Regis Pass appears to have replaced Sohon Pass on maps of the region.

Gustavus Sohon married Juliana Groh, April 29, 1863. Shortly thereafter he took his bride to San Francisco, Calif., where he established a "Photographic and Ambrotype Gallery," at 683 Market Street. Among his sitters was the famous Jesuit priest, Father De Smet, founder of the St. Mary's Mission to the Flathead Indians. An original Sohon negative of this subject is now in the collections of the Montana State Historical Society. In 1865 or 1866 Sohon gave up his photographic business and returned to Washington.

He retained his residence in Washington for the rest of his life, operating a shoe business and devoting much of his time to his growing family. Mr. Sohon was the father of eight children, five of whom lived to adulthood. His three sons attained distinction in the professions of law, medicine, and chemical research. Henry W. Sohon was a President of the Bar Association of the District of Columbia. Dr. Frederick Sohon accompanied Robert Peary as physician on three Arctic expeditions. Dr. Michael Druck Sohon isolated the chemical phenalthalein while at Johns Hopkins University. The only surviving child of Gustavus Sohon, Dr. Elizabeth Sohon, is a practicing physician in the city of Washington. Prof. Frederick W. Sohon, S.J., a grandson, is director of the world-famous Seismological Laboratory of Georgetown University.

Mr. Sohon never revisited the Northwest and the scenes of his decade of exploration between 1853-62. Nevertheless, his personal correspondence and the considerable number of copies of Government documents pertaining to relations with the Indians of the Northwest among his personal papers show that he retained an active interest in the welfare of the tribes he had known so well. His daughter recalls that members of the Flathead Indian delegation to Washington under Chief Charlot in 1884 paid a visit to Mr. Sohon at his home. The only time she saw her father smoke was when the pipe was passed around at the beginning of that meeting of old friends.

Gustavus Sohon died in Washington, D. C., September 3, 1903, at 78 years of age. He was buried in Mount Olivet Cemetery.

Three years before Mr. Sohon's death, Hazard Stevens' life of his father, Isaac I. Stevens, was published. The majority of the illustrations in this two-volume work are halftone reproductions of 22 original pencil portraits and 8 scenes drawn by Private Sohon during his service under Governor Stevens in the treaty-making operations

in the spring, summer, and fall of 1855. Hazard Stevens wrote of these illustrations:

The portraits of Indian chiefs were made by Gustavus Sohon, a private soldier of the 4th infantry, an intelligent and well educated German, who had great skill in making expressive likenesses. He also made the views of the councils and expedition. These portraits with many others taken by the same artist, were intended by Governor Stevens to be used to illustrate a complete account of his treaty operations. [Stevens, 1900, vol. 2, p. xx.]

Isaac I. Stevens was prevented from writing a history of his treaty operations by the pressure of public duties and later by his untimely death in battle in the Civil War.

Mr. Sohon's illustrations published in Hazard Stevens' book are listed in the Appendix, p. 68. They include portraits of the prominent Indian chiefs at both the Walla Walla and Blackfoot Treaty Councils. None of the prominent leaders of the Flathead and Pend d'Oreille tribes who participated in the Flathead and Blackfoot Treaties are portrayed.

In 1883 a collection of portraits of Northwestern Indians was given to the United States National Museum by Willard Jewell. It included nine pencil portraits of prominent Flathead leaders, eight portraits of chiefs and headmen of the Upper Pend d'Oreille, and three portraits of prominent Iroquois living with these tribes in the middle of the nineteenth century. The portraits were drawn by Gustavus Sohon while serving under Lieutenant Mullan the year before the Flathead Treaty. These may have been some of the "many other" portraits by Sohon, referred to by Hazard Stevens, which Isaac I. Stevens had intended to use in his proposed book on his treaty operations. Each portrait is on a separate piece of thin drawing board measuring about $7\frac{1}{2} \times 10$ inches. Each portrait bears a caption in Sohon's handwriting giving significant information on the subject of the sketch. These portraits are reproduced for the first time in this publication.

In 1947 Mr. Sohon's daughter, Dr. Elizabeth Sohon, presented to the United States National Museum 25 original drawings by her father, which were among his personal effects in her possession. Most of these drawings are scenes in the Indian country of the Northwest drawn in the years 1854-60. Several appear to have been the original field sketches in pencil which were copied at a later date in more finished form for some of Mr. Sohon's published illustrations. Others represent subjects that were never published. These drawings vary greatly in size; they probably were made on whatever paper was handy at the time of sketching. Some are on thin tracing paper in light pencil. The paper has deteriorated and the pencil lines now are

barely visible. A selection of these drawings, comprising those that have been identified and are sufficiently clear to be reproduced, has been employed in the illustration of this paper. In their present condition these drawings have scientific value, but do not constitute a fair representation of Mr. Sohon's artistic ability.¹

THE FLATHEAD INDIANS

They called themselves the Salish. However, the people of this tribe have been known to white men for more than a century as the Flat-head Indians. The origin of this name is uncertain. The neighboring Pend d'Oreille have a tradition that the Flathead practiced artificial head deformation when they arrived in the Bitterroot Valley from the west, at an undetermined time centuries ago. Yet the modern Flathead deny that their ancestors deformed their heads. (Turney-High, 1937, p. 12.) Some writers have used the term "Flatheads" loosely to designate the entire group of small Salishan tribes of the Upper Columbia River drainage. In 1851 Anson Dart, Superintendent of Indian Affairs for Oregon Territory, explained the application of the name to these tribes thus: "These Indians received the name Flat Heads from the fact that their heads were not sharpened by pressure on the forehead, as the Chinooks." (Ann. Rep. Comm. Ind. Aff., 1851, p. 478.) This suggests that the "Flatheads" were so named to designate people whose heads remained in the natural condition, flat on top, to distinguish them from the tribes of the Lower Columbia, whose custom it was to deform the heads of infants by artificial pressure in cradling.

¹ Although Gustavus Sohon's drawings comprise the most extensive and authoritative pictorial series on the Indians of the Northwestern Plateau in pre-preservation days; although he possessed remarkable talent; and although some 52 of his drawings have been published, his name does not appear in any of the standard biographies of American artists. Louise Rasmussen's "Artists of the Explorations Overland, 1840-1860," devotes three short sentences to Sohon.

This biographical sketch has been prepared on the basis of the published Government reports on the Pacific Railway Explorations and Surveys and the Military Wagon Road, on material in Hazard Steven's life of his father, on information in the files of War Department and State Department Archives in the National Archives, on a typed biographical sketch written by his son, the late Henry W. Sohon, in 1918, which is now in the William Andrews Clark Memorial Library, Los Angeles, and information graciously supplied by his daughter, Dr. Elizabeth Sohon, of Washington, D. C.

For valuable biographical information on the subjects of Sohon's Indian portraits, the writer is indebted to Pierre Pichette, Martina Siwahsah, and Baptiste Finley, Indians of the Flathead Reservation, Montana, interviewed in September 1947.

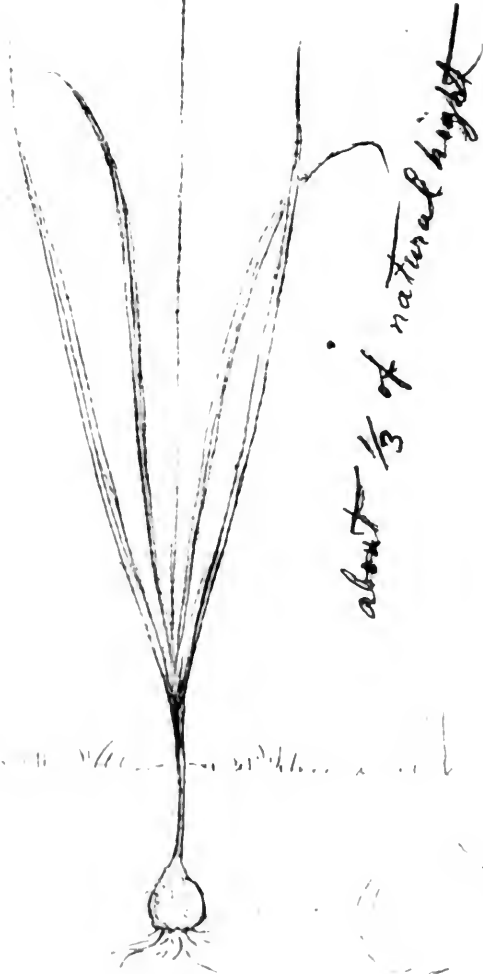
From the time of their traditional migration from the west until their final settlement on the Flathead Reservation in 1891, the true home of the Flathead tribe was the Bitterroot Valley, between the Rocky and Bitterroot Mountains in the southwestern part of the present State of Montana. This was beautiful wooded country, well stocked with deer, elk, bear, beaver, and wild fowl. Fish were plentiful in the streams. The fertile land yielded an abundance of edible wild roots and berries. The valley received its name from the bitterroot plant (*Lewisia rediviva*) which was especially plentiful there. By hunting, fishing, and collecting, the primitive Flathead gained ample subsistence in their valley home in pre-horse days.

The Flathead are believed to have obtained their first horses from Shoshonean tribes to the south during the first quarter of the eighteenth century. (Haines, 1938, p. 435.) After horses became numerous among them, the tribe made periodic journeys over the Rockies to hunt buffalo on the plains of the Upper Missouri. Regular seasonal migrations were customary in early historic times. In spring and summer the Flathead resided in the Bitterroot Valley, subsisting primarily on roots (of which the bitterroot and camas were most important), berries, small game, and fish. In June and July the men crossed the mountains on horseback for a brief summer hunt to obtain meat and buffalo hides for lodges. At the close of the berry season, in September or October, the whole tribe moved to the plains about the upper tributaries of the Missouri River to hunt buffalo. Usually they did not return to the valley until the next March or April, in time to dig the bitterroot. Fully half the year was spent on this long winter hunt.

The neighbors of the Flathead on the plains in the middle of the eighteenth century were the Pend d'Oreille and Kutenai on the north, and the Shoshoni on the north, east, and south. These friendly tribes recognized the right of the Flathead to hunt buffalo on a portion of the plains. It was as plains buffalo hunters that the Blackfoot Indians first met these people. Doubtless this accounts for the fact that the Flathead are regarded as a plains tribe in the traditions of the Blackfoot. (Thompson, 1916, pp. 327-328; Wissler, 1910, p. 17.)

In the latter half of the eighteenth century the powerful Blackfoot tribes, with the Piegan in the lead, pushed southwestward through present-day Alberta toward the Rockies and the northern tributaries of the Missouri River. Armed with deadly firearms, obtained from white traders on the Saskatchewan, and mounted on swift horses stolen from their southern and western enemies, these aggressive

natural size



Natural size



THE CAMAS, AN IMPORTANT FLATHEAD FOOD PLANT

intruders could not be repulsed by the bows and arrows, lances, and war clubs of the Flathead and their neighbors. The Blackfoot invasion gained momentum after a disastrous smallpox epidemic in 1781 greatly reduced the numbers of their enemies. The establishment of trading posts in their own country later in that decade also gave them a more plentiful supply of firearms and ammunition. By the close of the century the Blackfoot tribes dominated the western plains north of the Missouri. They forced the Kutenai, Pend d'Oreille, and Flathead to seek safety west of the Rockies, and pushed the Shoshoni southward and westward. The Blackfoot tried to deny the western tribes access to the buffalo plains by guarding the eastern exits from the most commonly used mountain passes. Occasionally they sent strong war parties over the Rockies to steal horses from the western tribes and to harass them in their own country. (Ferris, 1940, pp. 90-92; Thompson, 1916, pp. 304, 327-344; Teit, 1930, pp. 316-321.)

The Flathead and their neighbors insisted on their prior right to hunt buffalo on the plains in the present Montana. These tribes were too small to risk individual combat with the powerful Blackfoot. So they joined forces and crossed the mountains cautiously farther south on shorter hunting excursions. The expeditions of the period included the Nez Percé as well as the Flathead and neighboring Salishan tribes. In spite of their precautions these parties sometimes suffered heavy losses from attacks by the better-armed Blackfoot.

On these excursions the allied western tribes also met the Crow Indians, who had advanced westward across the plains of the Yellowstone River valley and taken over much of the territory previously held by the Shoshoni. Prior to 1805 the western allies traded horses and horn bows to the Crows for materials which the latter had obtained from the Mandan and Hidatsa villages farther east. Through these Crow middlemen the westerners obtained some articles of European manufacture, including a few brass kettles, which they cut into small pieces to ornament their hair and clothing. As yet the Flathead received no firearms. (Larocque, 1910, pp. 71-72.)

The first white men known to have met the Flathead were the members of the party of American explorers under Captains Lewis and Clark on their way overland to the Pacific. On September 4, 1805, this expedition encountered a Flathead village in what later became known as Ross's Hole, near the present town of Sula, Ravalli County, Mont. The explorers found the Flathead dressed in animal skins, living in skin-covered lodges, and subsisting at the time on roots and berries. Although interchange of ideas was complicated by the

fact that all conversation had to pass through six different languages, the Flathead managed to impress the explorers with their friendliness and hospitality by exchanging presents, willingly sharing their food, and trading horses to the whites. The expedition spent 2 days with the Indians, at the conclusion of which the Flathead set out for the Three Forks of the Missouri to join their western allies on the winter buffalo hunt. Lewis and Clark estimated the size of the Indian village at 33 lodges (Sergeant Ordway reckoned 40), in which lived about 400 persons, of whom 80 were men. Capt. Clark said these Indians called themselves "Eoote-lash-Schute." Later Indian accounts of the meeting leave no doubt that they were the Flathead. (Thwaites, 1904-5, vol. 3, pp. 52-55; Ordway, 1916, pp. 281-282; Wheeler, 1904, vol. 2, p. 65; Ronan, 1890, p. 41; Report of Explorations, etc., 1860, vol. 1, p. 325.)

Lewis and Clark estimated that the people of this village possessed over 500 horses of fine quality, an average of more than 15 horses to the lodge. Later accounts substantiate the fact that the Flathead were richer in horses than were the Indians of the Plains. (Irving, 1851, p. 117; Bradley, 1923, p. 256.) Flathead horses were sturdy, long-winded animals. A Blackfoot brave told Governor Stevens in 1853 that he "stole the first Flathead horse he came across—it was sure to be a good one." (Report of Explorations, etc., 1860, vol. 1, p. 148.) The theft of horses furnished a primary motive for Blackfoot raids on Flathead camps throughout the greater part of the nineteenth century.

When David Thompson of the Northwest Company crossed the Rockies and opened direct trade with the Flathead and Pend d'Oreille tribes in the fall of 1809, he found these Indians armed only with stone-pointed lances and arrows which broke harmlessly against the thick buffalo-hide shields of their Blackfoot enemies. These Indians clamored for firearms, ammunition, and iron arrowheads in exchange for beaver pelts. Little else interested them. (Thompson, 1916, p. 411.) During the following winter Thompson traded the Flathead more than 20 guns and several hundred iron arrowheads. Next summer the Indians were eager to try their new weapons against their old enemies. In July a party of about 150 Flathead and allied tribesmen crossed the Rockies by way of Marias Pass, determined to hunt boldly. The Piegan did attack them shortly after they reached the plains. The hardy Flathead successfully repulsed the attackers, with heavy losses to the Piegan. With the improved weapons the Flathead scored their first victory over the stronger Blackfoot.

Thompson credited the western Indians with being deadlier marksmen with their new weapons than were the Piegan. He believed this was due to the fact that they had learned to fire at smaller game from a distance, while the Blackfoot were accustomed to shoot buffalo at short range. (*Ibid.*, p. 411.)

Next year the Piegan, chastened by this defeat at the hands of their formerly impotent foes, sued for peace with the Flathead. It was a tempting offer to this small tribe that had suffered severe losses through decades of warfare with the Blackfoot. However, after long deliberation, the courageous Flathead leaders refused the peace offer. They knew that the Piegan could not speak for their Blood, North Blackfoot, and Gros Ventres allies, who remained hostile. (*Ibid.*, pp. 547-551.)

Within a few years the Flathead became well armed. The 168 Flathead men and boys who came to trade at the Hudson's Bay Company post at Horse Prairie in the fall of 1824 possessed 180 guns. (Ross, 1913, p. 387.) The Flathead were grateful to the traders whose guns and ammunition they believed had saved their little tribe from possible extermination at the hands of the merciless Blackfoot.

On the other hand, the traders were very much impressed with the character and integrity of the Flathead as compared with the Indian tribes they had known east of the Rockies and on the Pacific Coast. In the accounts of hard-boiled traders, the Flathead were extravagantly praised for their friendliness, frankness, honesty, truthfulness, industry, courage, obedience to their chiefs, cleanliness, and chastity of their women. (Cox, 1832, pp. 102, 122; Ferris, 1940, pp. 88, 325-326; Henry and Thompson, 1897, vol. 2, p. 710.) Yet the traders recognized that the Flathead had one serious failing, they were bold and inveterate gamblers. (Ferris, 1940, pp. 94-6; Thompson, 1916, pp. 411, 551; Wyeth, 1899, p. 193.)

Because of their admiration for the Flathead, many of the traders offered to aid them in their unequal struggle with the more numerous Blackfoot. Some traders, like Finan McDonald, accompanied the Flathead to the buffalo plains and fought beside them against their Indian enemies. (Cox, 1832, pp. 167-168.) Others sought to effect a peace between the warring tribes. Ross Cox, in 1813, tried to induce the Flathead to abandon their dangerous expeditions to the plains. He argued that their lands west of the mountains were well supplied with smaller game which could support them. But "they replied that their fathers had always hunted on the buffalo grounds; that they were accustomed to do the same thing from their infancy; and they would not now abandon a practice which had existed for several

generations." (Ibid., p. 121.) In the winter of 1832 Captain Bonneville tried to make peace between the western Indians and the Blackfoot. The Flathead, Nez Percé, and other western allies called a council to discuss the matter. In the end these Indians rejected Bonneville's proposal, on the logical grounds that a state of open warfare, during which everyone was constantly alerted, was preferable to the false security of peace with an enemy they could not trust. (Irving, 1851, pp. 121-122.)

While the Blackfoot waged a relentless war against American traders on the plains, the Flathead were uniformly friendly to both British and American traders. Through the fur trade their material culture was enriched with both utilitarian objects and luxuries—weapons and ammunition, metal tools, and household utensils; glass beads and garments of cloth. Aside from encouraging the Flathead to hunt valuable fur-bearing animals for the trade, and attempting to bring peace to the tribe, the fur traders were content to let the Indians live their own lives.

The appearance of Iroquois Indians among the Flathead was a by-product of the fur trade. Some time prior to 1825 a number of Iroquois men, who had been encouraged to leave their homes in the St. Lawrence Valley to hunt and trap for the fur companies in the far West, settled among the friendly Flathead. These Iroquois had received religious instruction from Catholic priests in the East, probably at the Jesuit Mission of Caughnawaga. They introduced among the Flathead some of the elements of Catholic worship as they recalled them, which were combined with elements of primitive Flathead religious ceremonials. The fur traders Wyeth and Bonneville reported the curious blend of Christian and native religious practices which they observed among the Flathead in 1833 and 1834. At that time the Flathead offered daily prayers and observed the cardinal holidays of the Roman Catholic Church. They considered Sunday a day of rest on which hunting, fishing, trading, and moving camp were forbidden, unless hunger or extreme danger from enemies prevailed. Each Sunday morning the people assembled to hear the moral teachings of their religious leader. The service was interspersed with singing and dancing in a great circle after the fashion of the older, native prophet dance. (Wyeth, 1899, pp. 193-194, 195, 196, 203; Irving, 1851, pp. 389-390; Spier, 1935, pp. 30-39.) However, these services consumed only a portion of their day of rest. The remainder of the day was celebrated as a secular holiday, in which the Indians indulged their love for gambling. Horse racing, the hand game, and



FLATHEAD INDIANS PLAYING RING, A POPULAR MEN'S GAMBLING GAME

other games involving wagers were played with fervor and keen delight. (Irving, 1851, p. 392.)

The Iroquois living with the Flathead encouraged them to sponsor a series of deputations to St. Louis during the 1830's, in quest of the "black robes," Catholic priests who could bring them the full benefits of Christianity.

In response to these persistent requests, Jesuit officials selected Father Pierre Jean De Smet, a Belgian priest, with 2 years' experience in missionary work among Indians, to visit the Flathead and determine the feasibility of missionary work among this far western tribe. He journeyed from St. Louis to Green River (in present Wyoming), where a Flathead delegation met him on June 30, 1840. They guided him to the main Flathead-Pend d'Oreille camp at Pierre's Hole. He found the Flathead hospitable and inclined to embrace the black robes' religion. De Smet baptized nearly 600 of the Indians, including the aged chiefs of both the Flathead and Upper Pend d'Oreille tribes. He assured them that a resident missionary would be sent them the following spring, and returned to St. Louis, enthusiastic over the prospects of a permanent Flathead Indian Mission.

Next spring Father De Smet headed the little party entrusted with the inauguration of the first Catholic Mission in the great Northwest. It included two other priests, Fathers Nicholas Point and Gregory Mengarini, and three lay brothers. In the fall of 1841, they established St. Mary's Mission in the Bitterroot Valley.

For 5 years St. Mary's Mission appeared to prosper. Father De Smet was not content merely to convert the pagan Flathead to Christianity. He initiated a series of fundamental changes in Flathead culture which he believed was necessary to improve the economic and social condition of the tribe.

The primitive Flathead had been accustomed to regard supernatural assistance as a powerful war medicine. Many warriors were attracted to Christianity as a source of stronger war medicine than they previously had possessed. A series of decisive victories of Flathead warriors over much larger enemy forces, following their conversion, convinced even their enemies that "the medicine of the Blackrobes was stronger than theirs." (Chittenden and Richardson, 1905, vol. 2, p. 589.) De Smet admired the courage of the Flathead, but he could not reconcile their interpretation of spiritual power as war power with the Christian ideal of universal peace. Like the fur traders before him, Father De Smet viewed the traditional Flathead-Blackfoot war-

fare as the greatest threat to the security and progress of the Indians. Primarily to prevent conflict on the buffalo plains, and secondarily to inculcate a "love of labor," which he deemed essential, among the Flathead, he attempted to "create among them a greater taste for agriculture than for hunting." He realized this would require "much time and patience." (Ibid., vol. 1, pp. 329, 366.)

To initiate this economic revolution, Father De Smet obtained seeds from Fort Colville and showed the Flathead hunters how to plant, cultivate, and harvest crops of wheat, oats, and potatoes. He also introduced cattle, hogs, and chickens from the western settlements. In 1845 the missionaries set up a flour mill to process their wheat, and a saw mill to provide lumber for permanent houses. A dozen small houses were built around the Mission as a further incentive to the Flathead to adopt a sedentary life.

De Smet recognized that until such time as the Flathead became experienced farmers, it would be necessary for them to continue their seasonal buffalo hunts. For a period a priest was sent with the hunting camp, but it soon became evident that serious religious instruction was impossible amid the savage excitement of the buffalo chase. Furthermore, the presence of a priest in the Flathead camp proved embarrassing on those occasions when battles with Blackfoot or Crow war parties on the hunting grounds could not be avoided. So the experiment of sending a priest with the hunting camp was abandoned. (Palladino, 1894, pp. 52-53.)

The changes wrought by Father De Smet in Flathead social life were profound. He aimed to eliminate those primitive Flathead social practices which appeared to be out of harmony with Christian morality.

Polygamy had been traditional with the Flathead. It was usual for a successful warrior and hunter to take more than one wife. A good hunter could provide more hides than a single woman could process. Several wives, therefore, were an economic asset to the ambitious Indian during the period of the fur trade. Furthermore, polygamy helped to provide for the excess of women in the tribe caused by heavy war casualties among vigorous, adult males. Father De Smet refused to recognize such multiple unions. He called upon each man to select one woman with whom he should appear before the priest for Christian marriage. (Chittenden and Richardson, 1905, vol. 1, p. 332.)

Flathead addiction to gambling was interpreted by Father De Smet as contrary to God's commandment, "Ye shall not covet anything

that is your neighbors." All their traditional gambling games, in which the Flathead had spent much of their leisure time, were abolished. (*Ibid.*, vol. 1, p. 227.)

In premissionary times the Flathead punished individual law-breakers by flogging. The traditional symbol of authority of a Flathead chief was a stout whip possessing fire-hardened rawhide lashes, which he applied vigorously to the bare back of each offender. It was customary for the guilty party to take his punishment manfully, without resentment against the chief. This was a cruel but effective method of enforcing tribal law. Father De Smet, impressed by the brutality of the chiefly flogging, discouraged this practice. (*Ibid.*, vol. 4, pp. 1225-1226.)

Fathers De Smet and Point accompanied the Flathead to the plains in the late summer of 1846. In September of that year De Smet succeeded in arranging a peaceful meeting between the Flathead and the Blackfoot. At the Piegan camp he was able to establish, by common consent among the leaders of these tribes, what he believed would be a lasting peace between these traditional enemies. He left Father Point to spend the winter with the Piegan and to begin missionary work among them, while he himself traveled down the Missouri to St. Louis. When he left the Flathead in the fall of 1846, Father De Smet was confident that the Mission, which he had founded among them, was flourishing. Yet 4 years later the Indians and missionaries had become so estranged that it was necessary to discontinue the Mission.

Many reasons have been given for the temporary abandonment of St. Mary's Mission in the writings of the missionaries. Father De Smet was accused of having made promises to the Indians which the missionaries who remained at St. Mary's could not fulfill. This De Smet vigorously denied. (*Chittenden and Richardson*, 1905, vol. 4, p. 1480; *Garraghan*, 1938, vol. 2, pp. 377-378.) Fathers Ravalli and Mengarini, who remained at the Mission through the 4 years after De Smet's departure, also stressed the point that the best Indians of the tribe had died since the Mission was founded, leaving a predominance of undisciplined individuals whose minds were poisoned against the missionaries by both white men and Indians who were either immoral characters or prejudiced against the missionaries and their work. (*Garraghan*, 1938, vol. 2, pp. 379-382; *Palladino*, 1894, p. 50.) Finally, the continued absence of the Flathead from the Bitterroot Valley for long periods on their buffalo hunts, left the Mission unprotected against Blackfoot attacks which endangered the

lives and property of the missionaries and their faithful assistants. By the fall of 1850 Catholic officials reluctantly recognized that the possibility of effective work among the Flathead had become so remote that further maintenance of St. Mary's Mission was not justified. On November 5, 1850, the Mission property was sold to John Owen, an American trader, who founded there a trading post, Fort Owen.

Contemporary accounts of the missionaries indicate that the Flathead change of heart became evident almost immediately after they left Father De Smet in the Blackfoot country in the fall of 1846. The Flathead are said to have given themselves up to obscenity and excesses of the flesh while still on the plains. When they returned to the Bitterroot Valley, the Indians greeted the missionaries coldly, pitched their lodges at some distance from the Mission, and were reluctant even to sell the missionaries dry meat of poor quality. (Ravalli in Garraghan, 1938, vol. 2, pp. 376-377.) Throughout much of the remaining period of the existence of the Mission, the Flathead avoided the Mission and were indifferent or hostile to the efforts of the missionaries on their behalf. They indulged their passion for gambling and "indecent" dancing, and refused to sell provisions to the Mission. (Ravalli in Garraghan, vol. 2, p. 380; Accolti in same, vol. 2, p. 383.) They no longer took their sick to the missionaries, but entrusted them to the treatment of native medicine men. Because the punishment of the whip had been abolished, some of their once influential chiefs, who deplored the actions of their people, were unable to exercise their traditional authority over their tribesmen. (Accolti in Garraghan, 1938, vol. 2, p. 382.)

In sum, these actions of the Flathead majority constituted a bloodless revolt against the planned socio-economic program inaugurated by Father De Smet. After 5 years of trial, they were unable to assimilate the alien, and to them meaningless, traits of European culture introduced by the missionaries as substitutes for their time-honored primitive customs. The contemporary accounts of the missionaries suggest that during the early period of their revolt against the austere moral code imposed by the Mission, the Flathead may have indulged in excesses that would not have been tolerated by their own leaders in premissionary days. However, for the most part, the Flathead reverted to their traditional pattern of existence.

Gambling was again popular. Polygamy was no longer forbidden. Their agricultural efforts were virtually abandoned. Four years after the sale of Mission property, George Gibbs observed that the Flathead

"live altogether by the hunt, and do not manifest any disposition to agricultural pursuits or fixed residence. . . . They have at the station a village of log houses, but notwithstanding generally prefer their own lodges." (Report of Explorations, etc., 1860, vol. 1, pp. 415-416.)

In 1855 Governor Stevens found many of the Flathead still unfriendly toward Indian Missions. After the conclusion of the Flathead Treaty on July 16, 1855, he wrote to the Commissioner of Indian Affairs: "Much difficulty was experienced in bringing the Tribes onto the Reservation in consequence of the dislike of the Flatheads for Mission Establishments." (Partoll, 1938a, p. 312.) Gradually Flathead opposition subsided. In 1866, at the Indians' own request, the Catholic Mission of St. Mary's was reestablished among the Flathead.

Like most intertribal peace treaties of the pre-reservation period, Father De Smet's Flathead-Blackfoot treaty of 1846 was short-lived. Within a few months the aggressive Blackfoot were harassing the Flathead again, both on the plains and in the Bitterroot Valley. Flathead losses again mounted. When the members of the Pacific Railway Survey parties visited the Flathead in 1853, they found Blackfoot aggression was still the greatest threat to Flathead tribal welfare. Governor Stevens estimated Flathead population at 60 lodges and 350 people, but many of the lodges were said to have been inhabited by widows and their daughters. (Report of Explorations, etc., 1860, vol. 1, p. 150.) Dr. Suckley reported that "but few pure Flatheads (are) left, the race having been almost exterminated by the Blackfeet. The mass of the nation now consists of Kalispelms, Spokanes, Nez Perces, and Iroquois who have come among them, together with their descendants." (Ibid., p. 295.)

As were the traders and missionaries before him, Governor Stevens was attracted by the fine qualities of the Flathead. Doubtless he was familiar with the writings of some of the earlier fur traders and of Father De Smet. Before he had met the Flathead, he wrote of them as "the best Indians of the mountains or the plains—honest, brave, docile—they need only encouragement to become good citizens." (Ann. Rep. Comm. Ind. Aff., 1853, p. 463.) He employed the authority of his office and his personal persuasive powers in an effort to bring about Flathead-Blackfoot peace. In 1853 he exacted promises from a number of the Blackfoot chiefs to cease their attacks on the Flathead. The Flathead leaders agreed to fight only in self-defense. However, the Blackfoot chiefs were powerless to restrain

their ambitious young braves. When Stevens returned to the Flathead in the summer of 1855, he was told how Blackfoot warriors had continued to steal large numbers of horses from Flathead camps and to kill peaceful Flathead on hunting excursions. The Flathead complained bitterly that they had suffered serious losses since 1853, but had kept their promise not to retaliate.

The Blackfoot Treaty of 1855, signed by both Blackfoot and Flathead leaders, designated a portion of the plains south of the Musselshell River as a proper buffalo-hunting ground for the Flathead and their allies from west of the Rockies. The treaty also pledged all the signatory tribes to intertribal peace. This treaty failed also to end warfare in the area. The chiefs who signed it could not enforce it among their own warriors. John Owen stated in 1860, "Since the treaty of '55 the Blackfeet have made frequent predatory Excursions to the different Camps from (on) this side and have run off many horses." (Owen, 1927, vol. 2, p. 215.) Sporadic clashes between Blackfoot and Flathead continued until the end of buffalo days nearly three decades after the treaty.

When Governor Stevens called the Flathead Treaty Council in the summer of 1855, the Indians hoped he would present a plan to halt Blackfoot depredations. Instead he told them of the Government's desire to place the Flathead, Pend d'Oreille, and that portion of the Kutenai living in the United States upon a single reservation comprising a small portion of the land claimed by those tribes west of the Rockies. The Indians were disappointed. Nevertheless, after Governor Stevens explained to them the many benefits offered by the Government in exchange for the cession of their lands outside the reservation boundaries, the majority of the chiefs appeared to accept the joint reservation proposal. Trouble arose when it came to the selection of a reservation site. The Flathead leaders refused to consider any location other than their ancestral home, their beloved Bitterroot Valley. The Upper Pend d'Oreille were unwilling to leave their homeland farther north about the newly established Catholic Mission of St. Ignatius. Negotiations appeared to have bogged down completely when Victor, the Flathead head chief, suggested a compromise, which Stevens accepted, and embodied in the formal treaty, signed by leaders of these tribes, and Governor Stevens as United States Commissioner, July 16, 1855. Article XI of this treaty read:

It is moreover, provided that the Bitter Root Valley, above the Loo-lo fork shall be carefully surveyed and examined, and if it shall prove, in the judgment of the President, to be better adapted to the wants of the Flathead tribe than the general reservation provided for in this treaty, then such shall be set apart

as a separate reservation for the said tribe. No portion of the Bitter Root Valley, above the Loo-lo fork, shall be opened to settlement until such examination is had and the decision of the President made known.

Governor Stevens immediately instructed R. H. Lansdale, Indian Agent, to make an examination of both localities. There exists in the National Archives, Department of the Interior, Office of Indian Affairs, correspondence, a manuscript report from Lansdale to Stevens, dated October 2, 1855, in which he expressed the opinion that the northern (Jocko) site was preferable to the Bitterroot Valley one. In reaching this opinion he considered the natural fertility and resources of the two areas. However, he acknowledged that the existence of the St. Ignatius Mission in the northern area weighed heavily in his choice of that location. This report was premature. It was made 3½ years before the Flathead Treaty was ratified by the Senate, April 18, 1859, and therefore had no legal status as the official Government survey specified in the treaty.

Meanwhile, as they waited for action to be taken on their treaty, the friendly Flathead were disillusioned and embittered by the fact that the Blackfoot Treaty, made 3 months later than theirs, was ratified in 6 months, and the Blackfoot tribes began to receive annuities and other benefits provided by that treaty. It appeared to the Flathead that the Government was following a policy of rewarding enemies and neglecting old friends. (Agent Lansdale, *in* Ann. Rep. Comm. Ind. Aff., 1857, p. 378.)

After the ratification of their treaty the Government made no effort to force the removal of the Flathead from the Bitterroot Valley. They were a small, friendly, well-behaved tribe, and they were still unwilling to move. In the wake of the Montana gold rush of the early '60's, white settlers moved into the Bitterroot Valley. Their settlements grew in area and numbers until the lands occupied by the Indians were virtually surrounded. Still the Flathead clung tenaciously to their land. Some Indians raised food crops for market as well as for their own consumption. But, as late as 1876, three and one-half decades after Father De Smet first showed them how to till the soil, the Flathead Agent reported, "a majority still derive their sustenance from hunting, fishing, root-gathering." (Ann. Rep. Comm. Ind. Aff., 1876, p. 88.) Until the extermination of the buffalo on the southern Montana plains in 1879-80, the Flathead continued their periodic buffalo-hunting excursions over the Rockies.

On November 14, 1871, President Grant issued an Executive Order declaring that all Indians residing in the Bitterroot Valley

should remove as soon as practicable to the Jocko Reservation. The next summer James A. Garfield met the principal Flathead chiefs to expedite the movement. They insisted that Article XI of the 1855 treaty had never been carried into effect, that the Bitterroot Valley had never been "carefully surveyed and examined," and that the white settlements that had been made in the valley since the treaty had been illegal. They considered that the Government's failure to comply with Article XI, was an admission that the valley should remain the proper home of the Flathead. Nevertheless, Garfield convinced Arlee, second chief of the Flathead, that it was to the best interest of the tribe to remove to the Jocko Reservation. He prepared a formal agreement of removal which bore the names and marks of the three principal Flathead chiefs. Although Head Chief Charlot's signature appeared on this document, Garfield acknowledged that Charlot did not sign it. (*Ibid.*, 1872, pp. 110, 115.)

In 1874 Arlee and a few of his followers removed to the Jocko Reservation. He became recognized by the Government as head chief of the tribe, and he and his followers received the Government's benefits. (*Ibid.*, 1888, p. 156.) From time to time small numbers of Flathead left the Bitterroot Valley and followed Arlee to the Reservation. The majority of the tribe remained with Charlot until several years after the extermination of the buffalo on the plains. Not until October 1891 did Charlot lead the remnant of his loyal, poverty-stricken followers, numbering less than 200 souls, from their beloved Bitterroot Valley onto the Jocko Reservation. (Palladino, 1894, p. 59.)

Once on the Reservation, this disillusioned, conservative leader continued to oppose Government-sponsored innovations in Indian life. Charlot opposed the Indian court of offenses, the Indian police force paid by the Government, the adoption of civilized dress, and threatened to take the children of his band from school if their hair was cut. (*Ann. Rep. Comm. Ind. Aff.*, 1892, p. 292.)

The history of Flathead culture in the pre-reservation period (i.e., prior to 1891), is significant as a case history in American Indian acculturation. Because the Flathead were consistently friendly toward the whites, because they placed high value on a number of traits of character which white men identified as Christian virtues, because they showed an early interest in the Christian religion, the fur traders, missionaries, and early Government officials believed this tribe aspired to a civilization after the European pattern. No other western tribe

appeared to offer such potentialities for rapid conversion to the white man's way of life. Yet Flathead history is one of obstinate resistance to acculturation. Their well-meaning white friends apparently failed to understand that the Flathead cherished certain primitive practices as traditional rights. Stubbornly they clung to their insistence on their right to hunt buffalo on the plains, despite the deadly opposition of the more powerful Blackfoot, and the kindly advice of their white friends, until the buffalo were gone. Persistently they asserted their right to remain in their beloved Bitterroot Valley homeland until their own poverty forced them to leave it. With equal courage they resisted efforts to introduce among them alien economic and social practices which were antithetic to their own cultural experience. No trait was more markedly characteristic of the primitive Flathead than was their independence. As a people they passionately desired to live their own lives and to make their own decisions.

Probably no one expressed more concisely the simple objectives of primitive Flathead life than did Father Mengarini, for many years their missionary, who wrote: "Generally the prayers of our Indians consisted in asking to live a long time, to kill plenty of animals and enemies, and to steal the greatest number of (the enemies') horses possible." (Mengarini, 1871-1872, p. 87.)

GUSTAVUS SOHON'S PORTRAITS OF FLATHEAD INDIAN LEADERS

The series of nine pencil portraits of Flathead leaders, drawn by Gustavus Sohon in the Bitterroot Valley in the spring of 1854, includes the likenesses of the majority of the responsible leaders of that remarkable little tribe in the middle of the nineteenth century. Most of these men were born before their tribe met white men. All were well known to the Catholic missionaries who founded St. Mary's Mission, and many of them were mentioned prominently in the writings of Father De Smet and his colleagues. They comprised the majority of the Flathead leaders who negotiated the tribe's first and only treaty with the United States a year after Sohon drew these portraits. Many of them also signed the important Blackfoot Treaty of 1855.

In the following biographical sketches of the subjects of Mr. Sohon's portraits, the artist's own brief but informative characterizations, written in his own hand on the same sheets as the portraits, are printed in smaller type beneath the name of the subject.

VICTOR, THE PRINCIPAL FLATHEAD CHIEF (PLATE 8)

Victor—

Head Chief of the Flatheads—

Victor has been confused by some writers with a contemporary of the same Christian name who was head chief of the Lower Pend d'Oreille. Father Palladino said that the Indians called the Flathead Victor "Mitt tó" and the Pend d'Oreille one "Pitol" to distinguish them. (Palladino, 1894, p. 63.) Pierre Pichette translated Victor's Indian name "Easy to Get a Herd of Horses." (See also Teit, 1930, p. 377.)

Victor said that he had been quite a good-sized boy when Lewis and Clark passed through the Flathead country in 1805 on their way to the Pacific. His father, Three Eagles, is said to have been a chief of the Flathead camp met by Lewis and Clark. (Owen, 1927, vol. 2, p. 42; Wheeler, 1904, vol. 2, p. 65.)

Victor's early years were molded by traditional Flathead religious beliefs. Pierre Pichette said that in his youth Victor obtained rabbit power by protecting a rabbit which was chased by a hawk. Some years later while stealing horses from the Crow, Victor was thrown from a stolen horse in the midst of the enemy encampment. He ran and hid in some brush near the camp. Although the Crow searched for him all through the next day they could not find him. The following evening Victor escaped. His rabbit power is credited with having saved him.

Victor was a minor leader of the Flathead when Father De Smet and his colleagues founded St. Mary's Mission. He was among the first Indians to accept Christianity and became the leader of the men's society organized by the priests. Agnes, his wife, led the women's society. Father De Smet credited Victor's leadership in the Catholic society as an important factor in his choice by the tribe as head chief, after the death of the octogenarian, Big Face, in late 1841 or early 1842. De Smet said Victor obtained tribal leadership "for no other reason" than "for the noble qualities, both of heart and head, which they all thought he possessed."

In the summer of 1846 Victor led the Flathead buffalo hunt to the plains, during which his people, augmented by 30 lodges of Nez Percé and a dozen friendly Blackfoot, scored a signal victory in a battle with the Crow. (Chittenden and Richardson, 1905, vol. 2, pp. 576-577.)

Later that fall Victor took a prominent part in Father De Smet's negotiation of a peace between the Flathead and Blackfoot at the



Victor -

Head of Victor, the Flathead -

VICTOR, PRINCIPAL FLATHEAD CHIEF

Piegan camp. De Smet was impressed by Victor's oratory at the meeting of the head men of the tribes in the priest's lodge:

Victor, head chief of the Flatheads, by the simplicity and smoothness of his conversation gains the good will of his hearers entirely. He begins by telling some of his warlike adventures; but as is easy to see, much less with the intention of exalting himself than to show forth the protection that the true God always grants to those who devote themselves to his service. [Ibid., p. 592.]

Among the many causes of the disaffection of the Flathead that led to the closure of St. Mary's Mission in 1850, Father Accolti mentioned the loss of influence of the chiefs following the abolishment of the punishment of the whip. (Garraghan, 1938, vol. 2, p. 382.) In the face of rising dissatisfaction with his leadership, Victor clung to his decision not to use the whip. Victor's close identification with the missionaries and his known piety also served to make him a target for abuse by the dissatisfied element. He deplored his people's change of heart, but seemed powerless to prevent it. Father Accolti wrote in the fall of 1852 that Victor had become only a nominal chief, especially since he had permitted a rival to strike him in the face without retaliating. (Ibid., p. 387.)

Governor Stevens visited Victor at Fort Owen in early October, 1853. He briefly recorded his impressions of the Flathead chief: "He appears to be simple-minded, but rather wanting in energy, which might, however, be developed in an emergency." (Report of Explorations, etc., 1860, vol. 12, pt. 1, p. 123.) Apparently that emergency was at hand the next time these two met, at the Flathead Treaty Council in the summer of 1855. When he visited Stevens 2 days before the formal Council opened, Victor complained of the failure of the Blackfoot to keep the peace promised by their chiefs 2 years earlier. He informed Stevens that 12 Flathead hunters had been killed by the Blackfoot and many horses stolen since the Blackfoot chiefs agreed to a peace. He mentioned that the Blackfoot had stolen horses seven times that spring. "Now I listen and hear what you wish me to do. Were it not for you I would have had my revenge ere this." (Partoll, 1938a, p. 286.)

It must have been a shock to Victor to find, after the Council opened, that Governor Stevens talked of land cessions and the placement of the Indians on a reservation, rather than of a solution to the pressing problem of Blackfoot depredations. Nevertheless, he retained his faith in Stevens' good intentions. "I believe you wish to assist me to help my children here so that they may have plenty to eat, and so that they may save their souls." Although Victor claimed

as his land the Flathead River country to the north occupied by the Upper Pend d'Oreille, as well as the Bitterroot Valley, he insisted that it was not a large tract. "There is a very little land here: I cannot offer you a large piece." (Ibid., p. 289.)

Victor was willing for all the tribes to go on one reservation but would not consider moving to the Flathead Valley. Alexander, the Upper Pend d'Oreille chief, preferred the northern location. In an effort to break the deadlock, Stevens expressed an opinion that the Bitterroot Valley was the better site because its climate was milder, it was nearer to camas and bitterroot, and more convenient for buffalo. But he could not convince Alexander. Hoping that time for private discussion might provide a solution to the problem, Governor Stevens declared the next day a holiday on which he feasted the Indians.

When the Council reconvened, Stevens believed majority sentiment favored the northern location. Therefore, he again described the treaty provisions and proposed a reservation within an area bounded by the Jocko River, Flathead Lake, Flathead River, and the mountains. He called on Victor to sign the treaty. Victor refused.

Then the Flathead chief, Ambrose, revealed that on the preceding day Alexander had approached Victor with an offer to move to the Bitterroot Valley, but Victor had refused to answer the Pend d'Oreille chief. After hearing this, Stevens lost patience with Victor and spoke sharply: "Does Victor want to treat? Why did he not say to Alexander yesterday, come to my place? or is not Victor a chief? Is he as one of his people has called him, an old woman? dumb as a dog? If Victor is a chief let him speak now."

Probably angry and somewhat confused, Victor replied that he had not understood Alexander's offer, that he recalled Governor Stevens had himself chosen the Bitterroot Valley as the better location. Then the lesser Flathead chiefs sought to explain Victor's silence of the previous day, stressing the variety of opinion among the Flathead, Victor's habitual thoughtfulness and slowness of speech. Probably Red Wolf stated the matter precisely when he said, "I know that if Alexander should come to the valley, his people would not follow him." Doubtless Victor had no more faith in the practicality of Alexander's offer. While the others continued to talk, Victor quietly walked out of the Council.

Governor Stevens decided to give Victor more time to consider. Next day, Saturday, Victor sent word that he had not made up his mind. The Council was postponed until Monday. (Ibid., pp. 301-308.)

Victor faced probably the most difficult problem of his life. He had agreed to the one reservation proposal. He knew, on the one hand, that Alexander's people were loath to leave the Mission and might not follow their chief if he agreed to move to the Bitterroot Valley. On the other hand, Victor knew that his own people were divided in their opinion. Moise, the Flathead second chief, was opposed to any land cession whatever. Bear Track, the powerful medicine man, refused to leave the Bitterroot Valley. Many of his people were still hostile to Missions and might refuse to follow him if he agreed to move to a reservation near St. Ignatius. His own position as chief was not strong. Should he make an unpopular decision, that position might be lost. Not only his own future but that of his tribe was at stake. Victor refused to be stampeded or shamed into a decision.

When the Council reopened on July 16, Victor offered a masterful compromise. He proposed that Governor Stevens send "this word to the Great Father our Chief—come and look at our country; perhaps you will choose that place if you look at it. When you look at Alexander's place and say this land is good, and say, come Victor—then I would go. If you think this above is good land, then Victor will say come here Alexander: then our children will be content. That is the way we will make the treaty, my father." (Ibid., p. 309.) Although the Pend d'Oreille would not accept this proposal, Governor Stevens accepted it as applicable to the Flathead only. The compromise was embodied in the Flathead Treaty as Article XI.

Victor emerged from the Council with greatly increased prestige. By the terms of the treaty he had been made head chief of the Flathead Nation, comprising all the tribes party to the treaty. His compromise, which permitted the Flathead to remain in their beloved homeland until and unless a careful survey showed that the northern locality was better land, was popular with his people.

During the remainder of the period in which the Flathead were without a Mission, Victor made periodic visits to the Pend d'Oreille Mission to fulfill his religious obligations. A number of his tribesmen went with him. When St. Mary's Mission was reestablished in the fall of 1866, it was in answer to the request of Victor, whose faith had never faltered.

For the rest of his days Victor made his home in the Bitterroot Valley, and his people did not desert him for the reservation to the north. He opposed every effort of the Government to get him to go on the reservation, even after white settlers took up land in his valley.

In 1872, after Victor's death, James A. Garfield stated that Victor had permitted, even invited, the first white settlers to live in the valley. (Ann. Rep. Comm. Ind. Aff., 1872, p. 110.) But by 1868 Victor complained to Major Owen of the white men who had located in the valley in defiance of the 1855 Treaty, which Victor said had set the area aside for the Flathead tribe. (Owen, 1927, vol. 2, p. 121.)

The Flathead Agent's report of 1869 describes the Flathead as:

. . . the wealthiest, most industrious and frugal of these confederated tribes. Many of them rely wholly on the products of their farms for subsistence, but the majority live and subsist in the fall and winter in the buffalo country. [Ann. Rep. Comm. Ind. Aff., 1869, p. 297.]

Victor himself was unable to adjust to the life of a sedentary farmer. In the years following the treaty he continued to lead his people to the plains for buffalo in the tradition of prewhite contact days. Scattered references in Major Owen's Journal refer to Victor's leadership of the summer hunt of 1856; the winter hunt of 1860-61, which occupied 7 months; the winter hunt of 1861-62, during which the tribe was absent from the valley for 9 months and many horses and some men were lost (presumably as a result of enemy action); and the summer hunts of 1865, 1867, and 1869. (Owen, 1927, vol. 1, pp. 136, 234, 253, 330; vol. 2, pp. 67, 138.)

In 1858 Victor was too ill to accompany the winter hunting party. He remained behind with three lodges of his people and was fed at Government expense. In mid-August, 1859, he was still an invalid, and Owen feared he would never recover his health. But he did. In the winter of 1867 Owen remarked at the amazing vitality of the old chief, whose hair was still black as coal and who could jump on a horse with as much agility as the youngest of his people. (Ibid., vol. 1, pp. 184-185, 193; vol. 2, p. 42.)

Victor died of sickness while on the summer hunt near the Three Buttes in 1870. He is said to be buried in the cemetery of St. Mary's Mission at Stevensville, in the Bitterroot Valley.

George E. Ford, the Flathead Agent, paid tribute to Victor in his report of September 1, 1870:

Affairs are particularly critical just now, as the confederated nation is without a chief. The Indians had full confidence in Victor and would cheerfully act according to his advice, but I know of no one in the nation that is capable of filling his place with equal ability. [Ann. Rep. Comm. Ind. Aff., 1870, p. 195.]

Father De Smet's tribute to Victor stressed his piety. Captain Mullan remembered Victor's mildness and gentleness, bravery, generosity, and his many kindnesses to the members of his exploring

Moise 2nd Chief of the Flatheads
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The Cradling Mountain
known among the Americans as Moise.

MOISE, SECOND CHIEF OF THE FLATHEAD

expeditions. Mullan suggested that the Indian Department should erect a monument to Victor's memory "to commemorate his worth and acts, and at the same time to teach all Indians that their good deeds never die." A portrait of Victor, as a "representative of the religious element," was sought for a proposed new volume of Thomas L. McKenney's "History of the Indian Tribes of North America." (Chittenden and Richardson, 1905, vol. 4, pp. 1337-1341.) The little town of Victor, on the Bitterroot River, 12 miles north of Hamilton, Mont., bears the name of this noted chief.

Victor was head chief of the Flathead for nearly three decades during a particularly trying period in the history of that tribe. Although at times his leadership may have suffered from want of firmness in dealing with dissident elements, his sincere goodness, quiet courage, patience, and dogged determination won him wide respect in his later years. Victor's compromise offered at the Flathead Treaty Council was a statesmanlike action. His insistence on the right of his tribe to remain in the Bitterroot Valley won him the approval of his own people and the respect of Government officials. For 21 years after his death, his son and successor, Charlot, held stubbornly to Victor's policy of refusing to leave the Bitterroot Valley for the established reservation. Until the decade of the eighties this policy expressed the will of the majority of the members of the tribe.

MOISE, SECOND CHIEF OF THE FLATHEAD (PLATE 9)

Steit-tish-lutse-so or the Crawling Mountain
Known among the Americans as Moise
2nd chief of the Flatheads, a talented and worthy Indian

Moise (French for Moses) received his Christian name on baptism by Father De Smet at St. Mary's Mission on Easter, 1846. De Smet said that he was surnamed "Bravest of the Brave." (Chittenden and Richardson, 1905, vol. 1, p. 305; vol. 2, p. 472.)

Moise told Lieutenant Mullan that he had been present in the Flathead camp in Ross' Hole when Lewis and Clark visited it in the fall of 1805. He said the explorers took what the Indians knew as the Southern Nez Percés' trail, following the Bitterroot River to its fork, after they left the Flathead village. (Report of Explorations, etc., 1860, vol. 1, p. 325.)

Moise headed the Flathead delegation that went to meet Father De Smet at Fort Hall in 1841. He sent ahead his finest horse as a gift to the priest. After their meeting De Smet described Moise as "the handsomest Indian warrior of my acquaintance" who was "dis-

tinguished by his superior skill in horsemanship, and by a large red scarf, which he wore after the fashion of the Marshals of France." (Chittenden and Richardson, 1905, vol. 1, p. 305.)

Moise remained a great favorite of Father De Smet, who called him his "adopted Indian brother" whose "exemplary conduct took pace with his renowned bravery and he was generally looked up to with esteem." As an example of Moise's moral refinement, De Smet recalled that on one occasion he and Moise had called upon a chief who had just flogged a visiting Nez Percé youth. Moise stripped off his buffalo robe, exposed his bare back, and called upon the chief to give him 25 lashes. When Father De Smet interposed, Moise explained, "Father, the Nez Percé here present was whipped because he talked foolishly to a girl. My thoughts are sometimes bewildering and vexing and I have prayed to drive them from my mind and heart." De Smet prevented the carrying out of this self-imposed punishment. (Ibid., vol. 4, pp. 1225-1226.)

De Smet told of Moise's calmness in encouraging his men before their successful battle with the Crow Indians east of the Rockies in the summer of 1846. "My friends," said Moise, "if it be the will of God, we shall conquer—if it be not his will, let us humbly submit to whatever it shall please his goodness to send us. Some of us must expect to fall in this contest: if there be any who are unprepared to die, let him retire; in the meantime let us keep Him constantly in mind." (Ibid., vol. 2, p. 576.)

In 1857 Father Menetrey named Moise among the four Flathead leaders who had never failed to follow the teachings of the missionaries after the closing of St. Mary's Mission. (Garraghan, 1938, vol. 2, p. 388.) Moise was one of the Flathead chiefs who journeyed to St. Ignatius to fulfill his religious duties in that year. (Chittenden and Richardson, 1905, vol. 4, p. 1240.) After his visit to the Flathead in 1859 De Smet termed Moise one of the greatest chieftains of the tribe, in whom real piety and true valor at war were united. (Ibid., vol. 2, p. 766.)

At the Flathead Treaty Council, Moise remained silent until he was asked to sign the treaty. He refused to sign. Then he launched a bitter denunciation of the treaty. He claimed the Flathead leaders would not have come to the council at all if Lieutenant Mullan had not assured them there would be "no talk of land," and that its purpose would be to offer help to the Flathead in their struggle against the Blackfoot. He refused to consider cession of any Flathead land. He had no faith in Governor Stevens' promise to make peace with

the Blackfoot. Although Moise was the only Flathead leader to express these ideas at the Council, and the only one to refuse to sign the treaty, it is possible he voiced the sentiments of a large segment of Flathead opinion. In the course of his remarks Moise also revealed his independence of Victor. When asked directly if Victor, who had already signed the treaty, was not his head chief, Moise replied bluntly, "Yes, but I never listen to him." (Partoll, 1938a, p. 311.)

Although Moise attended the Blackfoot Treaty Council that fall, and signed the treaty, he took no speaking part in the proceedings.

Scattered references to Moise's activities in the years following the treaties appear in Major Owen's Journal. In early April, 1857, Moise sought Owen's assistance to dissuade some of the young warriors from going to war against the Bannock and Shoshoni. During Victor's prolonged illness in 1858 Moise and Ambrose led the Flathead on their winter buffalo hunt. In March 1861 Moise brought up the rear of the Flathead camp on its return from hunting on the plains. In the winter hunt of 1862-63 he was a leader. On May 18, 1865, Moise started out with Victor and the Flathead party for the summer hunt east of the mountains but changed his mind and returned the next day in order to care for his growing crops. This is the only indication that any Flathead chief of the period was sufficiently interested in farming to permit it to interfere with his going to hunt buffalo. Apparently, even in this case, Moise had some difficulty reaching a decision in favor of tending his crops. (Owen, 1927, vol. 1, pp. 160, 190, 234, 277, 330.)

Moise died in March 1868, following a tedious year of sickness. Modern Flathead believe that he was buried in the Bitterroot Valley. At the time of his death Moise must have been over 70 years of age. Ambrose became his successor as second chief of the tribe. (Ibid., vol. 2, p. 95.) Moise, the headquarters of the National Bison Range, near Dixon, Mont., was named after Antoine Moise, a son, who was also a prominent Flathead leader.

Moise was a leader who combined the Christian virtues with the tough qualities necessary for survival on the northwestern Indian frontier in his time. He was honest, God-fearing, brave in war, and both independent and frankly outspoken in council. Later events proved that in his distrust of the possibility for a lasting peace with the Blackfoot, Moise possessed a keen and realistic insight into the military problems of the region.

AMBROSE, SUCCESSOR TO MOISE AS FLATHEAD SECOND CHIEF (PLATE 10)

Ambrose (in baptism)

Shil-che-lum-e-la, or Five Crows

A chief of the Flatheads, mentioned many times in the "Oregon Missions," for his bravery and generosity.

Father De Smet wrote Ambrose's Indian name "Sechelmeld." (Chittenden and Richardson, 1905, vol. 1, p. 320.) Father Palladino considered "Amelo or Ambrose" one of the notable men of the Flathead tribe. (Palladino, 1894, p. 63.) He is remembered by the modern Flathead by the names "Amelo" and "Five Crows."

In a battle with the Blackfoot in 1840 Ambrose counted coup by permitting an armed Blackfoot, who had mistaken him for one of his own tribe, to ride double with him, then wresting the enemy warrior's gun from him and killing him. (Chittenden and Richardson, 1905, vol. 1, p. 320. The editors state that Ambrose's own drawing of this action is among Father De Smet's papers.)

The Catholic missionaries considered Ambrose one of the Flathead leaders who remained loyal to their cause after the abandonment of the Mission. (Menetrey in Garraghan, 1938, vol. 2, p. 388; Chittenden and Richardson, 1905, vol. 2, p. 766.) Twice in 1857 he accompanied Victor to St. Ignatius to fulfill his religious obligations. Father Hoeken credited Ambrose with having played an influential part in a notable amelioration in the whole Flathead Nation in that year. Ambrose had "convened several assemblages, in order to arrange and pay off old debts, to repair wrongs, etc." (Chittenden and Richardson, vol. 4, p. 1240.)

During the Flathead Treaty Council, Ambrose revealed that Victor had refused Alexander's offer to move onto a reservation in the Bitterroot Valley, which resulted in Governor Stevens' relentless attack upon Victor. Ambrose quickly came to Victor's defense and attempted to restore calm to the proceedings by remarking, "I say to the white chief, don't get angry, maybe it will come out all right. Maybe all the people have a great many minds. Maybe they will come all right. See my chiefs are now holding down their heads thinking." (Partoll, 1938a, p. 305.)

Ambrose signed both the Flathead and Blackfoot Treaties. A year after he signed the Blackfoot "treaty of peace," his son, Louis, was killed by the Gros Ventres, a party to that treaty. (Chittenden and Richardson, 1905, vol. 4, p. 1248.)

Through the late fifties and sixties Ambrose continued to go on buffalo hunts with his tribe. During Victor's illness in 1858 he shared

Flat head



John
May 14th 1857

Ambrose in Flathead
with the name of his "Flathead"

As one of the Flatheads, he was seen in the
in the "Oregon mission", he his name was
generally -

AMBROSE, A FLATHEAD CHIEF

Flathead



*Ge. H. R. 1854
May*

Adolphe (in costume)

*A chief among his people, ruled as an
independent and of a sense. But he was
taken because he seems facile to repression.
He is the first to have been taken.*

ADOLPHE, A FLATHEAD CHIEF

with Moise the leadership of the Flathead hunting camp. Again in 1863 Ambrose and Moise led the Flathead hunting camp on the Musshell River. After the death of Moise, in the spring of 1868, Ambrose succeeded to the office of second chief of the Flathead. (Owen, 1927, vol. 1, pp. 190, 277; vol. 2, p. 101.)

The date of Ambrose's death is not recorded. However, we may assume that he died sometime between the end of March 1869 (when he was last mentioned by Owen, 1927, vol. 2, p. 133), and August 1872, at which time Arlee was recognized as second chief of the Flathead. (Ann. Rep. Comm. Ind. Aff., 1873, p. 251.)

As a leader, Ambrose exhibited admirable qualities of faith, courage, honesty, patience, and common sense. He showed remarkable coolness in battle and at the Flathead Treaty Council. His words of caution, offered at a crucial point in the Council proceedings, when tempers were aroused, helped to prevent a complete breakdown in negotiations.

ADOLPHE, A FLATHEAD CHIEF (PLATE II)

Adolphe (in baptism)

A chief among the Flatheads, noted for his independence and good sense. Not much liked because he never fails to reprimand any of his tribe who may deserve it.

Pierre Pichette said Adolphe's Indian name was "Wears his Hair in Small Twists," and that he was said to have used one of these twists to spank children who misbehaved. Adolphe's peculiar hair-dress is well illustrated in Sohon's portrait.

Martina Siwahsah remembered Adolphe as a powerful medicine man. She said she was present on a winter hunt on the plains when the snow was so deep the horses were dying of starvation. One evening the people heard someone singing. It was Adolphe making his medicine to bring a chinook. In the morning the chinook struck, and before evening the snow was all gone.

Peter Ronan said that Adolphe used to lead the Flathead against their enemies as their war chief. In a battle with the Gros Ventres about the year 1840 Adolphe and Arlee led the Flathead to a decisive victory. About half the Gros Ventres force, estimated at 100 warriors, were killed. (Ronan, 1890, pp. 76-78.)

The missionaries considered Adolphe one of the Flathead leaders who retained their faith and loyalty after the closure of St. Mary's Mission in 1850. (Menetrey in Garraghan, 1938, vol. 2, p. 338; Chittenden and Richardson, 1905, vol. 2, p. 766.) He journeyed to

St. Ignatius with Victor in 1857, to fulfill his religious obligations. (Chittenden and Richardson, 1905, vol. 4, p. 1240.)

Governor Stevens mentioned Adolphe among the principal men of the tribe whom he met on his first visit to the Flathead at Fort Owen, October 1, 1853. (Report of Explorations, etc., 1860, vol. 12, pt. 1, p. 125.) Adolphe signed both the Flathead and Blackfoot Treaties of 1855, but took no other part in the proceedings. "Adolphus Kwiikweschape, or Red Feather, chief of the Flatheads" was one of the group of chiefs of the mountain tribes who accompanied Father De Smet to Fort Vancouver in the spring of 1859 to renew the treaty of peace with the Commanding General and Superintendent of Indian Affairs. (Chittenden and Richardson, 1905, vol. 2, p. 766.)

When James A. Garfield, Commissioner for the Removal of the Flathead tribe of Indians from the Bitterroot Valley to the Jocko Reservation, met the chiefs of the tribe near Fort Owen in 1872, Adolphe, as third chief of the Flathead, was one of the tribal representatives. On August 27, 1872, he signed the agreement drawn up by Garfield providing for the removal of the Flathead to the reservation. Nevertheless, he joined with head chief Charlot in refusing to leave the Bitterroot Valley. Three years later Agent Medery removed Adolphe's name from the Government payroll, because he had "failed in every particular" to comply with the provisions of the agreement. (Ann. Rep. Comm. Ind. Aff., 1872, pp. 109, 114-115; 1875, p. 305.)

Adolphe marshaled and led the young warriors at the council held at the Flathead Agency September 2, 1882, to negotiate a right-of-way for the Northern Pacific Railway. Apparently before that date he had removed from the Bitterroot Valley to the reservation. Adolphe died at the Agency in 1887, at an assumed age of 78 years. (Ronan, 1890, p. 76.)

INSULA, A FLATHEAD CHIEF (PLATE 12)

Insula—or Red Feather

Michelle (in baptism)

A Flathead chief; according to Father De Smet "a great and brave warrior." He is noted for his piety, and officiates at the burial of the dead. He is quite an old man, nearly seventy.

Michael Insula (sometimes rendered Ensyla or Insala), Red Feather, was also known as "The Little Chief," because of his small stature. (Chittenden and Richardson, 1905, vol. 4, p. 1231.) Pierre Pichette thought Insula was not a name of Flathead origin. According to Duncan McDonald, he was half Nez Percé and half Flathead, and lived part time with the Flathead and the remainder of the time



1850
No. 247 1/2

Insula - a Flathead Chief
 mouth in profile

Chief of the Flathead Indians. Taken from
 a drawing by the artist in the collection of
 the Smithsonian Institution. Original in the
 collection of the artist.

INSULA, A FLATHEAD CHIEF

with the Pend d'Oreille. (Owen, 1927, vol. 1, p. 236, footnote.) De Smet stated (1841) that the Nez Percé had offered Insula the position of head chief of their tribe. He refused the honor saying, "By the will of the Great Master of Life I was born among the Flatheads, and if such be his will, among the Flatheads I am determined to die." (Chittenden and Richardson, 1905, vol. 1, p. 323.)

In the summer of 1835 Insula journeyed to the Green River rendezvous of the fur traders, where in company with a group of Nez Percé, he met the Protestant missionaries, Rev. Samuel Parker and Dr. Marcus Whitman. The Reverend Parker recorded his conversation thus:

Next rose Insala, the most influential chief among the Flathead nation, and said, "he had heard that a man near to God was coming to visit them, and he, with some of his people, together with some white men, went out three days' journey to meet him, but failed of finding the caravan. A war party of Crow Indians came upon them in the night, and after a short battle, though no lives were lost, they took away some of their horses, and one from him which he greatly loved, but now he forgets all, his heart is made so glad to see a man close to God." [Parker, 1844, pp. 81-82.]

Many years later Father Palladino explained that Insula was not satisfied with the appearance or the message of Parker and Whitman. He observed that they wore neither black gowns nor crosses, that they married, and did not have the great prayer, and that therefore these were not the priests of whom the Iroquois had told him. Consequently, he did not encourage them to go to the Flathead country. (Palladino, 1894, pp. 16-17.)

Insula was a great favorite of the Catholic missionaries. He was one of the party of 30 warriors who accompanied Father De Smet as far as Fort Alexander on the Yellowstone in the country of the enemy Crow Indians on De Smet's return eastward in 1840. (Chittenden and Richardson, 1905, vol. 1, pp. 266-267.) In 1841 De Smet termed Insula "the most influential of the Flathead chiefs," who "as a Christian or a warrior, might stand a comparison with the most renowned character of ancient chivalry." (Ibid., p. 324.)

Father Adrian Hoeken also had a marked personal regard for Insula. In the fall of 1855 he wrote De Smet of Insula's great bravery, tender piety, and gentle manners, and added that he had "preserved all his first fervor of devotion." Again in the spring of 1857 he wrote of Insula as "always equally good, equally happy, a fervent Christian, who is daily advancing in virtue and in perfection." He added that Insula had taught his young son, Louis Michael, to call the priest papa. (Ibid., vol. 4, p. 1245.)

Father Hoeken wrote that Insula "is well known and much beloved by the whites, who have occasion to deal with him, as a man of sound judgment, strict integrity, and one on whose fidelity they can implicitly rely." The priest called Insula "a keen discerner of the characters of men" who "loved to speak of those white men who were distinguished for their fine qualities." Insula adopted Col. Robert Campbell of St. Louis and Maj. Thomas Fitzpatrick as brothers. Colonel Campbell reciprocated by sending him a fine present in the spring of 1857. (*Ibid.*, pp. 1232, 1245.)

Of Insula's numerous deeds of heroism, Father De Smet cited but two, both of which occurred before 1841. On one occasion Insula "sustained the assaults of a whole village" of the enemy. On another, a party of Bannock, estimated at 200, who had visited Insula's camp and observed the small number of the Flathead, returned to attack the Flathead the next night. Advised of their intentions, Insula assembled his warriors to meet the attack. The small Flathead force killed nine of the enemy before Insula, in the heat of the pursuit, recalled that it was Sunday and ordered his warriors back to camp for prayer. (*Ibid.*, vol. 1, pp. 322-324, 365-366.)

According to Duncan McDonald, Insula was killed by Cree and Assiniboine on Milk River in October 1860. At that time the old man was living with the Kutenai and Pend d'Oreille. (Owen, 1927, vol. 1, p. 236, footnote.)

Little Insula appears to have possessed the most appealing personality among the Flathead leaders of his time. Not only was he very popular with the Indians of his own and friendly tribes, but he also proved adept at winning and holding the friendship of influential white men. Apparently he found subtle flattery, such as teaching his son to call the priest papa and adopting important white men as brothers, helpful in cementing these friendships. An ardent Catholic and a courageous warrior, he epitomized the missionaries' ideal of the Christian soldier.

BEAR TRACK, FLATHEAD CHIEF AND MEDICINE MAN (PLATE 13)

Soey-te-sum-'hi or Bear Track.

A Chief, and one of the very few pure Flathead Indians in the tribe. He is said to be a very brave and daring man, and is certainly one of the best looking men in the tribe, decision is written in every line of his countenance.

Bear Track spoke at the Flathead Treaty Council on July 13, 1855, after Victor's refusal to accept Alexander's offer to move to the Bitterroot Valley. He made no reference to Victor's action. He expressed his own willingness to make a treaty but emphasized the pov-

Flathead



Soley. to. com. 'ie, co
 Bear Track.

1874-1874

1874

Handwritten notes in cursive script, mostly illegible due to fading and slant. Some words like "Bear Track" and "Flathead" are partially visible.

BEAR TRACK, FLATHEAD CHIEF AND MEDICINE MAN

erty of his people and his opinion that the area around St. Ignatius Mission was not large enough for the proposed reservation. Bear Track signed both the Flathead and Blackfoot Treaties. (Partoll, 1938a, p. 306.)

Bear Track was famous as a medicine man. He was the maternal grandfather of Martina Siwahsah, who recalled some of Bear Track's remarkable feats. One spring the Indians were camped north of Hamilton in the Bitterroot Valley. A man and his wife went out hunting in the mountains. While his wife remained in the hunting camp, the man went on alone after game. She waited 3 days, but he did not return. Then she went back to the tribe and told Bear Track of her husband's disappearance. He sang, made his medicine, and said, "All I can see is the horse your husband was riding tied to a tree. I don't see the rider." He described the locality where he saw the horse. Men went to that place. They found the horse tied where Bear Track had indicated and the dead body of the hunter nearby. Apparently he had made a fire, gone to sleep, and a log rolled over and killed him.

Another time the people were hunting buffalo and could find none. Bear Track told the people to erect a long tent. He made his medicine, then told the people, "My power I received from a white buffalo calf. The buffalo are coming, and that calf will be in the lead." Next day a herd of buffalo appeared led by a white calf.

Teit also has reported Bear Track's power to find lost people and to bring the buffalo when they could not be found. He also stated that Bear Track had the power to foresee the approach of parties of enemy horse thieves and to warn his people in advance, as well as the power to foretell the results of battles. (Teit, 1930, pp. 384-385.) Turney-High found that no Flathead shamans were more highly respected than those who possessed such powers. (Turney-High, 1937, p. 29.)

Probably Bear Track was the most successful and most famous medicine man of his day among the Flathead. That he is not mentioned in the voluminous correspondence of the missionaries is understandable. It is unlikely that this medicine man of the traditional school looked with much favor upon the "magic" of the whites. Nevertheless, Martina Siwahsah said Bear Track was baptized and given the Christian name of "Alexander."

She said that Bear Track was married four times. He fathered 10 children. He lived to be a very old man, became blind, and died of sickness during the 1880's. Teit dated Bear Track's death about 1880, at over 90 years of age. (Teit, 1930, p. 384.)

PELCHIMO, A FLATHEAD CHIEF (PLATE 14)

Koilt-koi-imp-ty (Indian name)

Spoken of by Father De Smet as "Pelchimo", (by which name he is generally known,) as a good and brave Indian. He is a great favorite of all the whites who know him, for his honesty and good sense.

The modern Flathead remember him by both his Indian name and by the name "Palchina." They could not translate his Indian name exactly, because it is an obsolete form, referring to a blanket with some black on it.

Pelchimo was a brother of one of the Indians of the ill-fated third deputation (1837), the members of which were killed by the Sioux while en route to St. Louis to seek a priest. (Chittenden and Richardson, 1905, vol. 1, p. 292; Palladino, 1894, p. 30.) As "Palchinah" he signed the Blackfoot Treaty in the fall of 1855. His name does not appear among the signers of the Flathead Treaty.

Pelchimo was one of the heroes in the battle with the Blackfoot in 1840, in which Ambrose also distinguished himself. In this battle the Flathead, though greatly outnumbered, withstood their opponents for 5 days and finally forced them to retreat, leaving many killed and wounded on the battlefield. The Flathead lost but a single man, who died of wounds received in the battle. Pelchimo won honors in this fight by saving the Flathead horses from capture by the enemy. (Chittenden and Richardson, 1905, vol. 1, pp. 319-320.)

Pelchimo was a great friend of Major Owen. Owen frequently referred to him as "Palchina" in his Journals. In 1851 he accompanied Owen to Fort Loring on Snake River. They traveled together to The Dalles in the spring of 1855, and to Fort Benton in the summer of 1858. (Owen, 1927, vol. 1, p. 28-35.)

Owen considered Palchina the best veterinary in the region, and employed him to doctor his own favorite horses. He also had Palchina break his horses and permitted him to use the horses during the summer buffalo hunt in return for "getting them gentle." (Ibid., pp. 127-128.)

On April 4, 1863, Owen received a report that 70 horses had been stolen from Palchina's camp while en route home from the buffalo hunt on the plains. Two days later he was informed that Palchina had been killed by the party of Bannock horse thieves from whom Palchina sought to recover his stolen property. On hearing of Palchina's death, Owen paid high tribute to the man's character as one of the best Indians, brave when danger called, inoffensive but firm and exacting in his rights. (Ibid., pp. 278-279.)

Flathead



W. H. Holmes
May 12 1854

Holl. coi. m. h. l. Indian name,

name of a Flathead chief as Pelchimo, whose name is generally known, as a chief and his Indian name was ...

PELCHIMO, A FLATHEAD CHIEF

187.5007



John
Aug 15th 1874

Pacha.

136305

One of the chief men, of the Flatheads. - He is quite an old man -

His name is Lull-Lulle - aka. Kad-jent-



John
Aug 23rd 1874

"Lull-Lulle", or, Thunder

Said to be one of the best - of the Flatheads - Indians.

THUNDER, A FLATHEAD CHIEF

PACHA, A FLATHEAD LEADER

The written record appears to emphasize Pelchimo's prowess in the traditional men's occupations of the Flathead. He was a courageous fighter, a clever hunter, and a skilled trainer of horses. His talents as a horse doctor must have given him considerable prestige as a medicine man among the conservative members of his tribe. He was not mentioned by the missionaries among the Flathead leaders who remained staunchly loyal to their cause after the closure of St. Mary's Mission in 1850. Nevertheless, Sohon's testimony as to his good character is confirmed by the writings of Father De Smet and Major Owen.

THUNDER, A FLATHEAD LEADER (PLATE 15, LEFT)

Til-til-la or Thunder

Said to be one of the bravest of the Flathead Indians.

Father Palladino considered "Phidel Teltella, or Thunder," one of the notable men of the Flathead tribe. (Palladino, 1894, p. 63.) As "Thunder" he signed both the Flathead and Blackfoot Treaties in 1855, but he took no speaking part in the proceedings.

When disease in epidemic proportions raged in the Flathead camp in the summer of 1856, "Fidelis Teltilla" asked Father Menetrey to see his son who was dangerously ill. In the next year he accompanied Victor to St. Ignatius Mission to fulfill his religious duties. (Chittenden and Richardson, 1905, vol. 4, pp. 1239-1240.) Doubtless, the name "Fidelis" was given him by the missionaries in reference to his steadfastness in the Christian faith.

The modern Flathead say that Thunder died in the Bitterroot Valley before 1891.

PACHA, A FLATHEAD LEADER (PLATE 15, RIGHT)

Pacha

One of the chief men of the Flatheads—He is quite an old man.

(Indian Name) Quill-Quill-che-koil-pent.

Very little is known about this man. He was one of the principal men of the Flathead who met Governor Stevens at Fort Owen in the fall of 1853, on Stevens' first visit to the tribe. (Report of Explorations, etc., 1860, vol. 12, pt. 2, p. 125.) He may have been the Indian who signed the Flathead Treaty under the name of "Pah-soh." Doubtless he died within a few years after the treaty.

He was not remembered by any of the elderly Flathead questioned by the writer in 1947. They translated his Indian name, "Red Plume."

THE UPPER PEND D'OREILLE INDIANS

The Pend d'Oreille or Kalispel Indians lived in the region north and northwest of the Flathead in pre-reservation days. The name Pend d'Oreille ("Hanging Ears") was said to have been given them by early nineteenth-century fur traders because many of these Indians wore large shell ear ornaments at that time. Pend d'Oreille territory extended from the western base of the Rockies about Flathead Lake westward beyond Pend d'Oreille Lake into the northeastern portion of the present State of Washington. In the middle of the nineteenth century two major divisions of the tribe were recognized, the Upper Pend d'Oreille of the Flathead Lake region, and the Lower Pend d'Oreille in the neighborhood of Pend d'Oreille Lake. At that time the distinction was political as well as geographical. Each division possessed its own head chief and subchiefs. However, both groups spoke the same dialect of the Salishan language. It may be assumed that they were formerly one tribe. Teit obtained traditions from the Upper Pend d'Oreille to the effect that the Flathead Lake region was the traditional tribal homeland, and that the Lower Division was an offshoot of the Upper Pend d'Oreille. However, Dr. Suckley and Governor Stevens of the Pacific Railway Survey a half century earlier (1855) assumed that the Upper Pend d'Oreille division "had been formed at a comparatively recent period." (Teit, 1930, pp. 296, 303, 311; Report of Explorations, etc., 1860, vol. 1, pp. 149, 294.) The native name, Kalispel (meaning camas), was applied to the Pend d'Oreille in general by early fur traders. Some more recent writers have limited its application to the Lower Pend d'Oreille.

The Pend d'Oreille were more numerous than their Flathead neighbors. Anson Dart estimated Lower Pend d'Oreille population at 520, and that of the Upper Pend d'Oreille at 480, in 1851. In Major Owen's census of 1861 the Upper Pend d'Oreille totaled 184 families of 895 souls; the Flathead 90 families of 548 souls. (Ann. Rep. Comm. Ind. Aff., 1851, p. 478; Owen, 1927, vol. 2, p. 262.)

The Pend d'Oreille were mentioned less frequently by early nineteenth-century traders than were the Flathead. However, their history prior to 1840 paralleled that of the Flathead in general outline. Presumably they lived by hunting, fishing, and collecting in the area immediately west of the Rockies in pre-horse times. After they obtained horses, they crossed the mountains on seasonal buffalo-hunting excursions. Usually they hunted north of the Flathead, between the Rockies and the Sweetgrass Hills on the present International Boundary. (Partoll, 1937, p. 7.) They were driven off the plains by the

southwestward push of the Blackfoot prior to 1800. In 1811 an aged Kalispel told David Thompson that he had been a young warrior when his tribe first encountered an enemy war party with firearms. It was a Piegan force in possession of two guns. When they fired the new weapons, the Pend d'Oreille were so frightened they ran and hid in the mountains. But the Piegan sent strong war parties after them to kill men, women, and children, and to steal their horses. He acknowledged that his people had no adequate defense against the Blackfoot until Thompson traded them guns, which enabled them to regain much of their territory and to hunt buffalo on the plains again. (Thompson, 1916, p. 463.) The fact that the Pend d'Oreille were relatively rich in good horses prompted numerous Blackfoot raids on their camps through the first eight decades of the nineteenth century.

The Pend d'Oreille were hospitable to the Iroquois and their simplified Christian teachings. Some of the Iroquois married into the tribe. Many of the Upper Pend d'Oreille were baptized by Father De Smet and his colleagues at the Flathead Mission of St. Mary's prior to 1846. However, the first Catholic Mission to the Pend d'Oreille was established among the Lower Division, on the right bank of the Columbia River about 40 miles below Lake Pend d'Oreille, in 1845. This Mission was named St. Ignatius. The location proved unsatisfactory because of the severe winters and short growing season in that area. In the fall of 1854 it was moved to a more suitable site south of Flathead Lake, on what became known as Mission Creek, in the territory of the Upper Pend d'Oreille.

Father Adrian Hoeken, the first missionary to the Upper Pend d'Oreille, was very popular with the Indians. Loyalty to the Mission was an important factor in the refusal of the Upper Pend d'Oreille to accept a reservation in the Flathead country of the Bitterroot Valley some 75 miles south of their Mission. St. Ignatius Mission was situated within the area of the 1,300,000-acre Jocko Reservation established by the Treaty of 1855.

The Indians gathered about that Mission were a mixed group. Living with the Upper Pend d'Oreille in 1857 were some Iroquois, Nez Percé, Spokane, Kutenai, Coeur d'Alene, Kettle Falls Indians, Flathead, and Lower Pend d'Oreille, a few friendly Blackfoot, French half-breeds, and even several "creoles from the Creek Nation." (Chittenden and Richardson, 1905, vol. 4, pp. 1246-1247.) Father Hoeken and his colleagues encouraged the Upper Pend d'Oreille and these other Indians living with them to raise crops in the fertile soil of the

reservation by furnishing seeds, instruction, and as many agricultural tools as their limited means permitted. The Indian Agent's report for 1857 stated that they had made "very marked progress in cultivating the soil" in the 3 years since the Mission was established. Apparently some families found farming much to their liking. However, the Agents' reports during the two succeeding decades emphasized the preference of the majority for traditional economic pursuits. The 1865 Report stated that the Pend d'Oreille had made less progress in agriculture than had the Flathead. In 1869 the Agent wrote: "The greater portion of the Pend d'Oreille tribe and Kootenays still depend upon the chase for subsistence. The buffalo hunt, their main dependence, becomes each year less reliable." Yet in 1875 the Agent reported: "The greater number . . . make regular annual excursions to the east side of the Rocky Mountains on their accustomed buffalo hunts." (Ann. Rep. Comm. Ind. Aff., 1857, p. 379; 1865, p. 247; 1869, p. 295; 1875, p. 304.) As long as buffalo could be found on the plains beyond the mountains the majority of the Pend d'Oreille preferred the blood-quickenning excitement of running buffalo to the quiet, steady toil of tilling the soil.

The Indians' addiction to the seminomadic life also hampered the efforts of the missionaries to educate their children. A mission day school was established. But when Indian families moved camp to hunt, fish, gather roots or berries, they took their children with them. This continual interruption of their schooling for extended periods of time resulted in haphazard educational progress on the part of the children. (Ibid., 1865, p. 241.)

In their devotion to the traditional hunting economy, the majority of the Upper Pend d'Oreille, like the Flathead, postponed the problem of adjustment to an agricultural economy until after the buffalo were gone. In two other important respects, however, the cultural conflicts of the Upper Pend d'Oreille were more easily resolved than were those of the Flathead. The former never became estranged from their Mission, as had the Flathead in the late forties and fifties. St. Ignatius Mission has been in continuous existence since 1854. Also the Upper Pend d'Oreille were spared the frustration which the prolonged, unsuccessful struggle to retain their homeland brought to the Flathead. When Chief Charlot led his loyal little band of Flathead from the Bitterroot Valley onto the Jocko Reservation in 1891, the Upper Pend d'Oreille possessed nearly two generations of experience as reservation Indians.



Alexander (English name)

Tsim-eh kat-ek-tes' hidra-nim-mus.

130.315

Alexander, the principal chief of the Pend d'Oreilles is not a Pend d'Oreille proper but descended on the father's side from the Snake Indians and on the mother's from the Pend d'Oreilles. He was made chief by the Pend d'Oreilles themselves and by the Soviet Direct in 1848. He is noted for his high-toned, striking and noble traits of character. He was a brave man. When a party of his tribe had stolen horses from Fort Union on the Missouri in 1853, he started with only five of his men and carried them back, passing through the whole camp of the Blackfoot Indians, their most deadly enemies. He still retains a Pend d'Oreille look of hidra-nim-mus. 4878a and b.

ALEXANDER, HEAD CHIEF OF THE UPPER PEND D'OREILLE

GUSTAVUS SOHON'S PORTRAITS OF UPPER PEND D'OREILLE
LEADERS

The eight pencil portraits of Upper Pend d'Oreille leaders drawn by Gustavus Sohon in the spring of 1854 include likenesses of the three most important chiefs of the tribe during the period 1848-1890. These three, Alexander, Big Canoe, and Michelle, were signers of both the Flathead and Blackfoot Treaties of 1855. Bonaparte, a minor chief, is also included. The remaining four portraits of Choits-Kan, Pierre Nu-ah-ute-se, Louis Ramo, and Broken Leg (Kousheene), represent men of less standing in the tribe about whom no additional biographical information is available. Their portraits are not reproduced in this paper.

ALEXANDER, HEAD CHIEF OF THE UPPER PEND D'OREILLE (PLATE 16)

Alexander (English Name)

Tum-cle-hot-cut-se (Indian name)

Alexander the principal chief of the Pends-d-oreilles is not a Pend-d-Oreille proper but descended on the father's side from the Snake Indians and on the mother's from the Pends-d-Oreilles. He was made "First Chief" by the Pends-d-oreilles themselves and by the Jesuit Priests in 1848. He is noted for his high-toned, sterling and noble traits of character. He is a brave man. When a party of his tribe had stolen horses from Fort Benton on the Missouri in 1853, he started with only five of his men and carried them back, passing through the whole camp of the Blackfeet Indians, then most deadly enemies. He still rules the Pends-d-oreille tribe of Indians and is 45 years old.

Flathead Reservation Indians have translated Alexander's Indian name as "No Horses."

In addition to the return of the stolen horses, cited by Sohon above, other known exploits of Alexander testify to his courage. As a young man he volunteered to go alone to a trading post in the country of the hostile Crow Indians to obtain powder and lead which was badly needed by his tribe. Again, in the spring of 1856, after he had accompanied Major Owen to Fort Benton to obtain ammunition for his people, Alexander and two of his men set out alone on the return trip through the country of their Blackfoot enemies, killed nine buffalo on the plains, and rejoined Owen at the eastern base of the Rockies. (Ronan, 1890, pp. 73-76; Owen, 1927, vol. 1, pp. 118-121.)

Alexander succeeded Joseph as chief of his tribe. (Ronan, 1890, p. 73.) At the Flathead Treaty Council, he claimed to be chief of the Lower Pend d'Oreille as well. Governor Stevens promptly denied Alexander's claim to leadership of the Lower Pend d'Oreille or his right to speak for that group at the Council. (Partoll, 1938a, pp. 299-300.)

In the Flathead Treaty Council, Alexander clashed with Victor, the Flathead head chief, over the location of the reservation for the combined Flathead-Pend d'Oreille-Kutenai tribes. He readily agreed to Governor Stevens' proposal to place these tribes on one reservation, but he strongly favored the northern or Flathead Valley location. He argued that wild fruits and berries were plentiful there, that his crops grew well there, that it was a larger area than the Bitterroot Valley, and that the Kutenai and Lower Pend d'Oreille as well as his own people would prefer the northern location. When it became apparent that Victor would not accept this proposal, Alexander magnanimously went to Victor and offered to move to the Bitterroot Valley. But when Victor did not accept this offer immediately, Alexander withdrew it. Later Alexander offered to acknowledge Victor as his chief if Victor would accept the northern reservation. Again Victor was deaf to Alexander's proposal. Subsequently, Alexander refused Victor's compromise proposal to abide by the Government's decision as to the better location following a survey of the resources of both areas. He no longer would consider any reservation site but the northern one.

The Treaty, as finally drawn up and signed, secured to the Upper Pend d'Oreille their right to residence on a reservation in their traditional homeland. The Flathead Treaty, which was to plague Victor the rest of his life, was a complete victory of Alexander.

At the Blackfoot Treaty Council in October 1855 Alexander did not hesitate to express his dissatisfaction with both the location and the small size of the area proposed by the Commissioners as a buffalo-hunting ground for the western tribes. They had set aside a relatively limited tract east of the Rockies, west of the Crow territory, and south of the Musselshell River, as a common hunting ground in which the Blackfoot and the tribes from west of the mountains might hunt, but in which none of the tribes might establish permanent villages. Alexander vigorously championed the right of his people to hunt on the plains of present Montana, in the area the Commissioners wished to reserve to the Blackfoot. Alexander based his argument soundly on the traditional use of the area by his people, saying

A long time ago our people, our ancestors belonged in this country. The country around the Three Buttes. We had many people on this side of the mountains. . . . A long time ago our people used to hunt about the Three Buttes and the Blackfeet lived far north. When my Father was living he told me that was an old road for our people.

Alexander demanded to know why his people could not continue to cross the Rockies by the northern passes (referring probably to

the Cut Bank and Marias passes). Although Little Dog, a prominent Piegan chief, was impressed by Alexander's argument, the Commissioners remained firm in their decision that the country north of the Musselshell should be reserved for the Blackfoot tribes. The Treaty as written and signed by Alexander as well as the other Pend d'Oreille chiefs, gave the western Indians no right to hunt in the area reserved for the Blackfoot. (Partoll, 1937, pp. 7-10.)

Nevertheless, Alexander continued to hunt there. In 1860 he led his people on their winter hunt over the Rockies and across the plains of the Blackfoot country until they discovered buffalo on Milk River. After the people had thanked God for the prospect of a successful hunt, and secured their best horses for the morrow's chase, they retired for the night. While they slept, a large war party of Assiniboine and Cree Indians on foot surrounded the camp. An hour before dawn they launched a surprise attack, killed 20 of the Pend d'Oreille and wounded 25 more (5 of whom later died of their wounds). The enemy stole 290 Pend d'Oreille horses and forced the defeated camp to abandon most of their equipment, provisions, and clothing on the battlefield. Alexander led his beaten people on the 400-mile retreat homeward across the plains. Women with their children on their backs were forced to make the entire journey on foot. Major Owen met the party on its return to the Jocko Reservation. He found Alexander thirsting for revenge. Not only had his people suffered a humiliating defeat, but Alexander's son, a promising young man of 20 years of age, had been among those killed. Alexander had seen his son's scalped and mutilated body. He longed to return to the sleeping place of his son and people and to avenge their loss. (Owen, 1927, vol. 2, pp. 234-235, 239, 262.)

Alexander was deeply concerned with the problem of disciplining his people. In his first recorded speech at the Flathead Treaty Council he spoke frankly of his difficulties in managing his unruly young people. He believed that good example alone would not "make them go straight." Yet he feared the severity of the white man's laws. (Partoll, 1938a, pp. 289-290.) When Alexander accompanied Father De Smet to Fort Vancouver in the spring of 1859, he showed little interest in the white man's mechanical inventions and industrial plants he saw in the principal towns of Oregon and Washington. He was much interested in the Portland prison and the severe methods of punishment of criminals he observed there. Immediately on his return to the reservation, Alexander assembled his people. He told them of the wonders of the white man's civilization, placing particular emphasis

upon the white man's severe methods of criminal punishment, and concluded:

We have neither chains nor prisons, and for want of them, no doubt, a great number of us are wicked and have deaf ears. As chief, I am determined to do my duty; I shall take a whip to punish the wicked; let all those who have been guilty of any misdemeanor present themselves. I am ready.

The outcome of the affair was as follows:

The known guilty parties were called upon by name, many presented themselves of their own accord, and all received a proportionate correction. The whole affair terminated in a general rejoicing and feast. [Chittenden and Richardson, 1905, vol. 2, pp. 767-768.]

Alexander was a close friend of the Jesuit Missionaries. He often accompanied Father De Smet on his travels in the Rocky Mountain region. Father Hoeken credited Alexander with having selected the site for St. Ignatius Mission on its removal eastward in the fall of 1854. At the Flathead Treaty Council, Alexander declared, "The priest instructs me and this people here. I am very well content with the priest." At one point in the controversy over the location of the reservation, Alexander stated that he would agree to leave the area around the Mission and go on a reservation in the Bitterroot Valley if Governor Stevens would say that he could not go to heaven at his own place. His strong attachment to the Mission influenced his ultimate refusal to accept the southern reservation proposed by Governor Stevens. (Ibid., vol. 4, p. 1232; Partoll, 1938a, pp. 290, 300.)

Alexander died about the year 1868. (Teit, 1930, p. 377.) Thus he served as head chief of the Upper Pend d'Oreille for two decades. His leadership was courageous, aggressive, strict, and apparently just. There is no record of Alexander's position ever having been seriously challenged by a rival leader of the tribe. His chieftaincy was marked by continued friendship with the whites and sporadic warfare with the plains tribes. Alexander was an economic conservative. At the time of his death the Upper Pend d'Oreille still made periodic hunting excursions to the plains for buffalo.

MICHELE, SUCCESSOR TO ALEXANDER AS UPPER PEND D'OREILLE HEAD CHIEF
(PLATE 17)

Whe-whitth-schay (Indian name)

Michelle (English name)

Is noted for his upright and manly conduct, he was well thought of among the Jesuit Priests who gave him the name Michelle. He is remarkable for his generosity, which is the significance of his name.

Michelle's Indian name means "Plenty of Grizzly Bear." He was a minor chief of the tribe when Alexander died, and was elected head

130.305
1854



130.305
1854

130.305
The-Whitth-schay Indian name
Michelle English name

So called for his upright and manly conduct - he was not the only one among the Jesuit Priests who gave him the name of Michelle. It is a name which has no relation to which is the signification of his Indian name.

MICHILLE, SUCCESSOR TO ALEXANDER AS UPPER PEND D'OREILLE
HEAD CHIEF

chief after two others, André and Pierre, declined the office. (Teit, 1930, p. 377.) He was probably one of the Michelles who signed the Flathead Treaty and possibly the Michelle who signed the Blackfoot Treaty in 1855. He took no speaking part in either Council. As Pend d'Oreille head chief he represented the tribe in the Council to negotiate for the right-of-way of the Northern Pacific Railway on the reservation, September 2, 1882, and at the meeting with members of the subcommittee of the United States Senate appointed to visit the Indian tribes of northern Montana on September 7, 1882. (Ronan, 1890, pp. 54, 76.)

In his Annual Report of September 1874 Peter Whaley, the Flathead Agent, recommended that Michelle should be replaced by André, second chief of the tribe. The Agent pointed out that on their buffalo hunts east of the mountains the Pend d'Oreille were in the habit of stealing horses from friends and foes alike and refused to return the animals to their proper owners. Michelle, who at the time was physically unable to accompany his people on their hunts, was powerless to prevent the thefts or to compel restitution. André, on the other hand, had the confidence of his people and was the real leader of the tribe. (Ann. Rep. Comm. Ind. Aff., 1874, pp. 262-263.) The new Flathead Agent in 1875 reported that André was "chief in all but drawing a salary from the government." (Ibid., 1875, p. 304.) Agent Peter Ronan investigated the cause of the dissension in 1877. He found Michelle a "good-meaning" man who had to a large extent lost contact with his people. Michelle lived at the Agency while his people were located near St. Ignatius Mission some 20 miles away. When decisions needed to be made, André, who lived with the tribe, generally made them. If a case was later taken to Michelle, he generally reversed André's decision, causing further dissatisfaction. Michelle seemed well aware of the fact that he had lost contact with his people and considered moving back to live among them in order to regain his lost influence. (Ibid., 1877, p. 136.)

Michelle's popularity was not increased by his severe punishments. He whipped female adulterers, common among his people, so severely as to cause the deaths of some women. Agent Medery found it necessary to prevail upon Michelle to resort to milder punishment. (Ibid., 1876, p. 89.)

In spite of the dissatisfaction of many of his people, the opposition of André, and the recommendation of at least one Agent that he be deposed, Michelle continued in the position of head chief. He won the respect of Agent Ronan during the Nez Percé War of 1877.

Fearing that the Agency Indians might join their old allies, Ronan prepared to remove his wife and children from danger. Michelle went to the Agent and pledged that his warriors would protect Ronan's family from harm. The Pend d'Oreille remained friendly. (Clark, 1885, p. 301.)

A few years earlier, Michelle's friendship for the whites had been put to a severe test. His son had been accused of the murder of a white miner. Although the son swore his innocence, Michelle told him he could not be saved, or his death avenged, except by war with the whites, and asked the young man to sacrifice his life for the good of his people. The youth was hung by enraged whites. (Ibid.)

Michelle helped to set an example for his people in agriculture. In 1885 he had 160 acres under fence, producing 250 bushels of wheat and oats. In the spring of 1887 he purchased young fruit trees for his land 16 miles north of the Mission. (Ann. Rep. Comm. Ind. Aff., 1885, p. 127; 1887, p. 138.)

Michelle died at his home, near the present town of Ronan, about 1890. He is said to have been buried in the cemetery at St. Ignatius Mission.

Although he possessed admirable personal qualities, as a leader of his people Michelle proved a rather ineffective successor to the active and aggressive Alexander.

BIG CANOE, SECOND CHIEF OF THE UPPER PEND D'OREILLE (PLATE 18, LEFT)

In-er-cult-say

Known as the "Big Canoe."

Full-blooded Pend d'Oreille, second chief—Rather a dark Indian, about 55 or 60 years old.

Big Canoe is said to have been born in 1799. (Handbook of American Indians, etc., 1910, pt. 1, p. 146.) At the Flathead Treaty Council, he made a point of the fact that his aunt told him he was "pure Pend d' Oreille." (Partoll, 1938a, p. 293.) Pierre Pichette translates his Indian name, "Rotted Under the Belt," which probably refers to a rotten scalp carried under the belt as a trophy.

Peter Ronan stated that Big Canoe "was considered by the Indians to be one of the greatest war chiefs the tribe of the Pend d'Oreille ever had," and that "stories of battles led by him against Indian foes would fill a volume." (Ronan, 1890, p. 73.) Unfortunately, none of those deeds have been recorded in the literature.

At the Flathead Treaty Council in 1855 Big Canoe delivered a lengthy speech. He could not understand why discussion at the Council involved the problem of Indian land. To his mind no real

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...the name of the man ...

BIG CANOE, SECOND CHIEF OF THE UPPER PEND D'OREILLE



Bonaparte is the name of the man ...

BONAPARTE, A PEND D'OREILLE CHIEF

land problem existed. The whites and Indians could live peaceably side by side. He pointed with pride to the fact that his people had never spilt blood of the white man. Why then should there be a treaty? He attributed the continued friendship between his people and the whites to the fact that white traders had furnished guns and ammunition to repel their powerful enemies, and for this his people continued to be grateful. However, he resented the fact that the whites also traded these things to the Blackfoot who used their weapons against whites as well as Indians. He referred to Governor Stevens' promise to put an end to Blackfoot depredations. He pointed out that since the Blackfoot promised peace in 1853, they had broken it many times. They had stolen one of his horses the previous winter, and his own daughter had been set afoot when they stole two horses that very spring. He had kept his promise not to retaliate against the Blackfoot, not because he was afraid of them, but because the white man had asked him to keep the peace. To Big Canoe this matter of Blackfoot hostility was the only important problem for discussion at the Council.

Governor Stevens made no direct reply to Big Canoe. He guided the discussion back to the subject of the choice of a reservation for the Indians. Big Canoe remained silent through the remainder of the Council. At its conclusion he signed the Treaty. (Partoll, 1938a, pp. 291-294.)

At the Blackfoot Treaty Council, Big Canoe spoke briefly in support of Alexander's claim of the right of the Pend d'Oreille to hunt buffalo on the plains north of the Musselshell. He spoke bluntly, "I am glad now we are together. I thought our roads would be all over this country. Now you tell us different. Supposing we do stick together, and do make a peace. . . . Now you tell me not to step over that way. I had a mind to go there." Later he concurred in the expressed desire for peace of the Piegan chief, Lame Bull, saying "Don't let your war parties hide from me. Let them come to our camps as friends." (Ibid., 1937, p. 8.)

Big Canoe was a strong character. Although a war leader, he had a sincere desire for peace. To his mind peace seemed to promise unrestricted freedom of movement. He could not reconcile his idea of peaceful relationships with the whites and other Indians with the talk of separate tribal hunting grounds and restricted reservations that was current at the Councils.

Big Canoe died at the Flathead Agency in 1882 at the advanced age of 83. He was buried in the Indian Cemetery at St. Ignatius Mission (Ronan, 1890, p. 72).

BONAPARTE, A PEND D'OREILLE CHIEF (PLATE 18, RIGHT)

Bonaparte (English name)

Kols-seese-Kol-lay (Indian name)

Bonaparte a Pend-d-oreille chief is noted for his generosity and benevolence to his tribe and especially to those who are poor or needy. He is rich in horses and cattle and a person is never known to be in need without his assisting him and relieving his wants. He is a man of thirty-five years of age.

Pierre Pichette said that Bonaparte's Indian name was an obsolete form which he was unable to translate. Apparently he was a minor chief in 1855, for his name is not signed to either the Flathead or Blackfoot Treaties.

Major Owen, in May 1856, told of a half-breed named Bonaparte who attempted to arrange a horse race between his prized mount and a Nez Percé race horse. However, Bonaparte's horse, which he had obtained from the Spokan country 2 years before in exchange for six horses, bore such a reputation for speed that its owner could get no other Indians to race against it. (Owen, 1927, vol. 1, pp. 125-126.)

Indians living on the Flathead Reservation today say that Bonaparte died in the 1870's.

THE IROQUOIS AMONG THE FLATHEAD AND PEND D'OREILLE

The fact that there were Christian Iroquois living in the camps of the primitive Flathead and Pend d'Oreille before the middle of the nineteenth century has whetted the curiosity and imagination of students of Indian history. These Mohawk Iroquois were living more than 2,000 airline miles from their native villages in the vicinity of Montreal, Quebec. When and why did they make the long trek westward through the lakes and forests, across the plains and the great Continental Divide?

The first Iroquois to travel into the northwestern wilderness beyond the eastern forest belt were sturdy Mohawk canoe men employed by the fur traders who outfitted and marketed their furs in Montreal. By the late years of the eighteenth century these traders had established posts on the Saskatchewan River and its tributaries as far west as the present Province of Alberta, in the shadow of the Rockies.

As early as 1798 or 1799 a second wave of Iroquois moved westward. In company with a large number of Nepissings and Algonquians, a group of Iroquois men (and a very few women) followed the canoes of the fur traders to the headwaters of the Saskatchewan to hunt and trap independently. The number of Iroquois in this migration has been estimated at from 40 to more than 100. On the

western plains they met the Blackfoot, Gros Ventres, Sarsi, and Cree, aboriginal inhabitants of the region. The partially acculturated Iroquois who had been instructed in the Catholic religion at Caughnawaga Mission near Montreal felt themselves superior to the barbaric plains Indians, which so enraged the latter that the Blackfoot or Gros Ventres attacked the Iroquois and killed about a score of them. Friendly Cree advised the Iroquois that it would not be safe to try to revenge this defeat. (Mackenzie, 1903, vol. 2, p. 345; Thompson, 1916, pp. 311-317.)

One small colony of Iroquois, reputed to have been descendants of two brothers of this migration, still remains in Alberta, under the name of Michel's Band. This band, now under the jurisdiction of the Edmonton Agency, numbered 104 persons in 1944. (Gibbons, 1904, pp. 125-126; Census of the Indians in Canada, 1945, p. 3.) The remainder of the original group scattered after their disastrous battle with the plains tribes. Perhaps many of them returned to the East. In February 1810 David Thompson, at Saleesh House (near present Thompson's Falls, Mont.), west of the Rockies, employed six Iroquois "who had come this far to trap Beaver" to assist him in collecting birchbark for canoes. (Thompson, 1916, p. 418.) Thus it is certain that some Iroquois, possibly remnants of the large group of the 1798-99 migration, reached the country of the Flathead and Pend d'Oreille by the end of the first decade of the nineteenth century, only 5 years after the pioneer explorers Lewis and Clark. Some of the members of that early migration may have settled eventually among the friendly Flathead.

However, the group of Iroquois who were primarily responsible for giving the primitive Flathead and Pend d'Oreille their first notions of Christianity have been credited to another and somewhat later migration. Father Palladino stated that they comprised a group of 24 Iroquois under the leadership of Ignace Lamoose, who wandered westward until they reached the land of the Flathead, where they were hospitably received and decided to remain. (Palladino, 1894, pp. 9-10; Chittenden and Richardson, 1905, vol. 1, p. 20.) This explanation sounds reasonable only if we may assume that members of the party were encouraged, and perhaps even guided, by Iroquois who had been among the Flathead before that time and had returned east with flattering descriptions of the country and its people.

The date of this migration is uncertain. Father Palladino placed it between 1812 and 1820; Father De Smet, 1816, and Father Mengarini, as late as 1828. (Palladino, 1894, p. 9; Chittenden and Richardson, 1905, vol. 1, p. 29; Garraghan, 1938, vol. 2, p. 238, footnote.)

The Iroquois Ignace Lamoose, also known as Old Ignace or Big Ignace to distinguish him from a younger Ignace of the party, was the individual primarily responsible for introducing Christian religious practices among the Flathead. Father Palladino termed him the "Apostle to the Flathead." He it was who taught them to say the Lord's Prayer, make the sign of the Cross, baptize their children, and observe Sunday as a day of rest. (Palladino, 1894, pp. 9-10; Mengarini in Garraghan, 1938, vol. 2, footnotes pp. 238 and 241.)

He it was, also, who urged the Flathead to send deputations to St. Louis to seek a Catholic missionary to the tribe. He personally led two of the four deputations which traveled from the Northwest toward St. Louis in the 1830's.

Much has been written about the so-called "first deputation" of 1831, but it has never been determined satisfactorily whether the four Indians of that party who appeared in St. Louis in October 1831 were Nez Percé or Flathead, or contained one or more Indians of both tribes. There is also some question whether the deputation was motivated by religious or secular desires. It is certain that publicity resulting from the appearance of these Indians from the distant Northwest in St. Louis attributed their journey to a desire to obtain "The White man's Book of Heaven," and that this publicity led to the establishment of the first Indian Missions in the Northwest by Protestants between 1834 and 1836. These Missions were located among the tribes of the old Oregon country far to the west of the Flathead. (Chittenden and Richardson, 1905, vol. 1, pp. 21-27; Garraghan, 1938, vol. 2, pp. 237-238, 242-246.)

There is less uncertainty regarding the membership and motives of the other three deputations. All three were incited by Iroquois living among the Flathead. Two deputations were composed entirely of Iroquois; the third was led by one. Active Flathead participation was limited to the third deputation.

The second deputation was a family affair. After the Flathead chief, Michael Insula, determined that the missionaries who were sent west in 1835 were not Catholics but Protestants, he returned home and told his people of the disappointment. In the summer of 1835 Old Ignace and his two sons set out for the east. They reached St. Louis safely in the fall. The sons of Old Ignace were instructed and baptized by the Jesuits there. On baptism December 2, 1835, they were given the Christian names of Charles and Francis. Their father told Catholic officials of the western Indians' desire for a priest. He received a promise that a black robe would be sent to the Flathead

if circumstances permitted. Old Ignace and his sons returned home the following spring. (Palladino, 1894, p. 19; Chittenden and Richardson, 1905, vol. 1, pp. 28-29; Garraghan, 1938, vol. 2, p. 246.)

In 1837 a third deputation consisting of three Flathead, a Nez Percé, and Old Ignace as leader started for St. Louis. At Fort Laramie they joined a party of white men traveling eastward from Oregon. At Ash Hollow on the North Platte they were attacked by a party of Sioux. The whites were ordered to stand aside as the Sioux did not intend to molest them. Old Ignace who was dressed as a white man, was mistaken for one, and ordered to stand with the whites, but he refused to abandon his Indian companions. The Sioux then attacked the five Indians and killed them. It is possible that the Sioux mistook the Indians for Shoshoni, traditional enemies of their tribe. Thus no member of this deputation lived to reach St. Louis. (Palladino, 1894, p. 20; Chittenden and Richardson, 1905, vol. 1, p. 29; Garraghan, 1938, vol. 2, pp. 247-248.)

In the summer of 1839 two Iroquois, Pierre Gaucher and Young Ignace, volunteered to make the long trip to St. Louis in quest of a priest. Apparently they traveled down the Yellowstone and Missouri Rivers by canoe. In St. Louis, Bishop Rosati gave them assurance that a priest would be sent to their people the following spring. Pierre Gaucher set out for home alone, while Young Ignace waited at Westport to accompany Father De Smet westward in the spring. (Palladino, 1894, pp. 21-24; Chittenden and Richardson, 1905, vol. 1, pp. 29-30; Garraghan, 1938, vol. 2, pp. 248-250.)

Bishop Rosati was told by the Iroquois of this last deputation that only 4 of the 24 Iroquois who formerly emigrated from Canada to the Flathead country were still living in 1839. It is probable the Indians meant that only that number remained among the Flathead, and that in addition to others who had died since the migration, some of the Iroquois had moved on to other locations. Father Garraghan stated that a group of Catholic Iroquois emigrated from the Rocky Mountain region to the site of Kansas City and that among the first Catholic baptisms in the history of that city, February 23, 1834, two were recorded as "Iroquois-Flatheads." (Palladino, 1894, p. 28; Garraghan, 1938, vol. 2, p. 239, footnote.)

GUSTAVUS SOHON'S PORTRAITS OF IROQUOIS LIVING AMONG THE FLATHEAD

Mr. Sohon's three portraits of Iroquois living among the Flathead were drawn in the late spring of 1854, probably in the vicinity of

Fort Owen in the Bitterroot Valley. Sohon's own captions on these drawings make no mention of the religious activities of these subjects. However, the historic significance of these portraits lies primarily in the fact that the men depicted played important roles in the extension of Christian Missions to the tribes of the northern Rockies. Certainly two, and probably all, of these Iroquois were members of Indian deputations to St. Louis during the 1830's in quest of a priest. These are the only known portraits of these men.

IROQUOIS PETER (PLATE 19)

Pierre Kar-so-wa-ta

An Iroquois who came to this country thirty years ago, and settled here. He is the most industrious indian in the valley, cultivates a small farm raising wheat, oats, potatoes, etc. and owns a large band of cattle; he speaks the mountain french and english, besides several Indian languages.

Pierre Pichette said that "Kar-so-wa-ta" was not a Salishan name. Charles A. Cooke, a student of Iroquois personal names, believes this may be the Iroquois name, Gah-sa-wé-ta, meaning Lime or Chalk. An Iroquois from St. Regis, who bore that name, was said to have been in the northwest in 1818.

Of the four Iroquois said to have been living among the Flathead in 1839, only one Pierre or Peter has been identified. He was the Pierre Gaucher (or Gauche) of the 1839 deputation. This is probably a portrait of that man.

Pierre Gaucher (Left-Handed Peter) was one of the two young Iroquois who volunteered to make the long journey to St. Louis in 1839 to obtain a priest for the Flathead. Apparently they journeyed down the Yellowstone and Missouri Rivers, through hostile Indian country, in the company of fur traders returning to St. Louis. Father De Smet met them on September 18, when they passed St. Joseph Mission at Council Bluffs. He stated that these Indians had been "for twenty-three years among the nation called the Flatheads and Pierced Noses" (Nez Percé), and that "the sole object of these good Iroquois was to obtain a priest to come and finish what they had so happily commenced." He gave them letters of recommendation to the Father Superior in St. Louis. (Chittenden and Richardson, 1905, vol. 1, pp. 29-30; Palladino, 1894, p. 21.)

In St. Louis Peter and his companion, Ignace, were hospitably received by the Catholic officials who were favorably impressed by their piety and character. They found that both of the Iroquois spoke French and that one of them carried a little book printed in

Iroquois

of the Iroquois
of the Iroquois
of the Iroquois



of the Iroquois
of the Iroquois

Peter Kanawaka

The following is a description of Peter Kanawaka, an Iroquois Indian, who was sent to the United States by the British in 1760 to assist in the construction of Fort Mifflin. He was one of the few Iroquois who remained loyal to the British during the Revolutionary War. He was killed at the Battle of Red Bank in 1777.

IROQUOIS PETER

his own language, from which the Iroquois sang a number of sacred songs. Bishop Rosati recorded in his diary that these Iroquois had reached the Flathead country in 1816 (which tallies with De Smet's statement above). (Garraghan, 1938, vol. 2, p. 238, footnote; pp. 248-250.)

After receiving assurances that a priest would be sent to the Flathead the following spring, Peter set out alone for home. He traveled through the winter and arrived in the Flathead camp the next spring, where he conveyed the welcome information that a black robe was coming. (Palladino, 1894, p. 24.)

Peter the Iroquois has been credited with the baptism of a dying Flathead girl on the site later occupied by the St. Mary's Mission. Before her death this girl called out, "Listen to the Black Robes when they come; they have the true prayer; do all they tell you. They will come and on this very spot where I die, will build the house of prayer." In later years the Flathead regarded her statement as prophetic. (Palladino, 1894, pp. 35-36; Chittenden and Richardson, 1905, vol. 1, p. 293.)

Father Mengarini named Peter, Big Ignace, and Little Ignace as the three Iroquois most influential in giving the Flathead their first knowledge of Christianity. (Garraghan, 1938, vol. 2, p. 238, footnote.) However, little is known of Peter's religious activities after the founding of St. Mary's Mission to the Flathead. He was not mentioned in the writings of the missionaries during the remainder of his lifetime.

At the time of the Pacific Railway Survey, Peter was the most successful and conscientious farmer in the Flathead country. Lieutenant Mullan stated that when he left Cantonment Stevens to explore southward to Fort Hall, October 14, 1853, Pierre the Iroquois was the only Indian at St. Mary's village. Apparently all the Flathead were hunting buffalo east of the Rockies. (Report of Explorations, etc., 1860, vol. 1, p. 319.)

Governor Stevens' estimate of Flathead population in 1853, at 60 lodges and 350 people, was based directly on a statement by Peter. (Ibid., pp. 150, 295.)

When the question of the relative fertility of the Bitterroot Valley and the region around St. Ignatius Mission was raised during the Flathead Treaty Council, Governor Stevens called upon Peter, as the most experienced farmer in the region, to render an opinion. Peter frankly replied that he did not know which area was better for farming. (Partoll, 1938a, p. 297.)

In the latter part of May, 1856, Iroquois Peter was killed in a fall from his horse while he and his wife were hunting elk. Major Owen reported his death and stated that he was an old trapper who had been a long time in the country. (Owen, 1927, vol. 1, pp. 127, 129.) Father Hoeken stated that the family of Iroquois Peter was settled at St. Ignatius Mission among the Upper Pend d'Oreille in the spring of 1857. He acknowledged that "the death of this venerable old man is a great loss to the mission." (Chittenden and Richardson, 1905, vol. 4, p. 1246.)

Apparently this migrated Mohawk, descendant of a traditionally horticultural people, set an excellent example to the Flathead in agriculture and herding after seeds and livestock were brought to the Bitterroot Valley by Father De Smet in the early forties. His example was not heeded by the majority of the Flathead. Probably much of the agricultural progress attributed to the Flathead by visitors to the Bitterroot Valley in the middle of the nineteenth century was, in fact, the fruit of the individual effort of Iroquois Peter.

IROQUOIS AENEAS (PLATE 20)

Iroquois—"Aeneas"—

Came to this country with Pierre, but has not the industry or forethought of his "comrade" Pierre. He is poor but an honest and reliable man.

The name "Aeneas" is readily recognized by present-day Indians on the Flathead Reservation as an American attempt to render the Flathead pronunciation of the French name "Ignace." Baptiste Finley, a 76-year-old mixed-blood living on that reservation, said that the Iroquois, Ignace, was his maternal grandfather. Baptiste volunteered the information that this man, known as "Ignace Chapped Lips" to the Flathead, was the Iroquois who went to St. Louis with the party that was successful in obtaining a priest for the tribe, and that he returned with the first priest. Sohon's "Aeneas," therefore, was the "Young Ignace" or "Petit Ignace" who was one of Ignace Lamoose's most influential helpers in giving the Flathead their first knowledge of Christianity; who accompanied Pierre to St. Louis in 1839 to seek a priest; who spent the winter of 1839-40 in Wesport waiting for the priest; and who accompanied Father De Smet on his first journey over the Rockies to the country of the Flathead. (Garraghan, 1938, vol. 2, p. 238, footnote; Chittenden and Richardson, 1905, vol. 1, pp. 29-30.)

Young Ignace was one of the party who journeyed to Fort Hall to meet Father De Smet on his return to the West in the spring of

Iroquois -



Iroquois -

Same Iroquois as in the preceding drawing. In
 addition to the usual Iroquois dress he wears
 a long fur angora and rabbit skin

IROQUOIS AENEAS (IGNACE)

hair rich and
intensely black.
Some hair on the
eye brows, (as exception
amongst Indians)



J. Johnson
Jan 1854

Lamuk Indian name
Charles (in baptism) 30305

Charles Lamoose

1/2 Popovos 1/2 Pend d'Oreille
Lives England Head
a ...

CHARLES LAMOOSE, MIXED IROQUOIS-PEND D'OREILLE

1841. "Iroquois Ignatius" also accompanied the priest on his visit to the Crow Indians in the summer of 1842. (Chittenden and Richardson, 1905, vol. 1, p. 399.)

Aeneas rendered valuable service to Lieutenant Mullan's exploration of the intermountain region in the winter of 1853-54. Mullan reported:

I learned, through an old Iroquis Indian, called Aeneas, now resident in the Bitter Root Valley, whose wanderings amid the mountains had often thrown him with parties travelling with wagons at the southward, thereby rendering him capable of judging of the requisites of a wagon road, that a line could be had through a gorge-like pass in the Coeur d'Alene mountains. Our later explorations proved this to be Sohon's Pass. [Mullan, 1863, p. 5.]

In March 1854 Lieutenant Mullan sent one of his topographers, with Aeneas as a guide, to make a special examination of the locality Aeneas had recommended. Snow prevented their reaching the pass. Five years later Gustavus Sohon made the first scientific exploration of this pass that for many years bore his name. (Ibid.)

Aeneas outlived his more ambitious comrade, Peter. Father Hoeken wrote from St. Ignatius Mission in the spring of 1857, "old Ignatius is settled here." (Chittenden and Richardson, 1905, vol. 4, p. 1246.) Baptiste Finley said that Aeneas had two children, both of whom are now dead, and that Aeneas himself died about 1880, and was buried in the old Indian cemetery near Arlee.

The record indicates the Aeneas was of a more restless disposition than his friend and fellow tribesman, Peter. He was a wanderer whose knowledge of geography proved valuable to the Government explorers.

CHARLES LAMOOSÉ, SON OF OLD IGNACE (PLATE 21)

Lamuh (Indian name)

Charles (in baptism)

Charles Lamoosé— $\frac{1}{2}$ Iroquois and $\frac{1}{2}$ Pend-d'oreille speaks English and French and lives with the Flatheads.

Charles Lamoosé was the eldest son of Old Ignace Lamoosé, the Iroquois whom Palladino termed "the Apostle to the Flatheads." As a boy he accompanied his father and younger brother on the long and perilous journey to St. Louis to seek a priest for the Flathead. He was baptized Charles by Father Helias in St. Louis on December 2, 1835. His brother received the name of Francis Xavier. Father Helias gave Charles' age as 14, his brother's as 10. He also stated that the boys were able to speak a little French, were handsome, very intelligent, and that their mother was a Flathead. (Garraghan, 1938, vol. 2, pp. 246-247.)

Charles and his brother were of the party of 10 lodges of Flathead who went to meet Father De Smet on his return to the West in July 1841. (Chittenden and Richardson, 1905, vol. 1, p. 30.)

Unless this man was the "Charles" who accompanied Father De Smet on many of his travels in the northwest as interpreter, his name was not mentioned in the later literature. Baptiste Finley said Charles Lamoose died in the Bitterroot Valley prior to 1891. His brother Francis Lamoose, also known as Francis Saxa, lived to old age among the Flathead and was a well-known and respected informant on Flathead cultural history.

SIGNIFICANCE OF THE SOHON PORTRAITS

The white man's penetration of the northwestern interior of our country came late. It advanced rapidly. The period of transition from first exploration to extensive white settlement, which in some sections of the country required centuries, was a matter of decades in the Northwest. The explorer, the fur trader, the missionary, the Indian agent, the gold seeker, and the farmer-settler, met and left their impress on the lives and customs of the Indians of the Northwest in a little more than a half century. Indians born into a Stone Age aboriginal culture lived to witness the extermination of the buffalo, the filling up of their land with settlers, and their confinement on reservations.

In the face of this rapid extension of white civilization, the relatively small native tribes of the Northwest struggled to retain their political, social, and economic independence. Two of those tribes were the Flathead and the Upper Pend d'Oreille. Major responsibility for working out an adjustment to the changed conditions of life and solving the many knotty problems posed by the extension of the white man's culture to their country was assumed by the elected chiefs of these tribes. Although these leaders differed markedly in their opinions of what was best for their people, they acted with such courage, sincerity, and friendliness as to win the admiration and respect of the white men with whom they dealt. Probably no group of Indian leaders in American history have been so extravagantly praised by the whites as were the Flathead and Pend d'Oreille chiefs of the middle of the nineteenth century. Mr. Sohon's portraits depict the majority of those chiefs as they appeared in the year of 1854. His portraits have given form and substance to some of the strongest Indian characters in western history.

The appearance of the subjects of Sohon's portraits illustrates the Indians' selective adaptation of traits of the white man's culture.

The long forelock, falling over the center of the forehead to the nose, was apparently an aboriginal style of hairdress among the Indians of many tribes. George Catlin and Karl Bodmer depicted it in many of their portraits and scenes among the tribes of the Northern Plains in the 1830's. (Wissler, 1910, p. 152.) Sohon illustrated it in his portraits of Cayuse, Nez Percé, and Blackfoot leaders in 1855. The style became obsolete among the Flathead before 1891. The peculiar visored trade caps, worn by many of Sohon's subjects, were a style of headgear which was in great favor among the Flathead in the mid-nineteenth century. These caps were shown in less detail in the scenes of Flathead life drawn by Father Nicholas Point a decade earlier. (De Smet, 1847, plates facing pp. 119 and 151.) They were also worn by Cayuse and Spokane Indians sketched by Sohon in 1855.

A similar cap was worn by a Red River half-breed drawn by Frank B. Mayer in 1851. (Mayer, 1932, p. 58.) The origin of these caps is not known. This distribution suggests that they may have been obtained from Hudson's Bay Company traders. Victor's tall hat and Iroquois Peter's unusual cap of gray trade cloth are other examples of nonaboriginal headgear in use at the time. The shirts with attached, turned-over collars, and buttons at the neck certainly show white influence. Catholic influence appears in the crucifixes worn by some of these Indians. The only articles of traditional clothing illustrated in the portraits are the buffalo robes worn as outer garments by Moise and Alexander.

Hazard Stevens, who was present at the Walla Walla and Blackfoot Treaty Councils of 1855, when Sohon drew a number of Indian portraits, observed that Gustavus Sohon "had great skill in making expressive likenesses." Presumably the Flathead, Pend d'Oreille, and Iroquois portraits, sketched from life by Mr. Sohon a year earlier, possess that same quality. With the single exception of the unsigned portrait of Big Canoe, which appears so labored and crude as hardly to be the work of the same artist, Sohon's pencil technique is characterized by clean, sure lines, and a very realistic three-dimensional quality. His portraits of Flathead leaders show the prevalence of "good-looking" men in that tribe which was noted in the observations of Dr. Suckley of the Pacific Railway Survey. (Report of Explorations, etc., 1860, vol. 1, p. 292.) His Iroquois portraits show the characteristic long-facedness of those people. At his best, in the portraits of the Flathead leader, Pelchimo, and the three Iroquois, Sohon's portraits deserve to rank with the finest works of white artists who visited the western Indian country in pre-reservation days.

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APPENDIX

A LIST OF PREVIOUSLY PUBLISHED DRAWINGS BY GUSTAVUS SOHON

COLORED LITHOGRAPHS AFTER SOHON DRAWINGS PUBLISHED IN "REPORT OF EXPLORATIONS AND SURVEYS TO ASCERTAIN THE MOST PRACTICABLE AND ECONOMICAL ROUTE FOR A RAILROAD FROM THE MISSISSIPPI RIVER TO THE PACIFIC OCEAN, MADE UNDER THE DIRECTION OF THE SECRETARY OF WAR, IN 1853-5," vol. 12, book 1. Washington, D. C., 1860. (Processed by "Sarony, Major & Knapp, Liths., 449 Broadway, N. Y.")

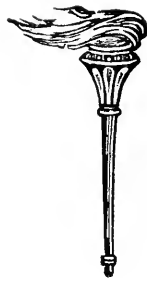
- Fort Vancouver, W. T. (Following p. 154.)
Hot Spring Mound, in the "Deer Lodge" Prairie of the Rocky Mountains. (Facing p. 172.)
Crossing the Hellgate River May 5, 1854. (Facing p. 179.)
Entrance to the Bitter Root Mountains, by the Lou Lou Fork. (Facing p. 180.)
Cantonment Stevens, Looking Westward. (Facing p. 181.)
Great Falls of the Missouri River. (Facing p. 183.)
Main Chain of the Rocky Mountains, as Seen from the East—Extending from a Point North of the Marias Pass to near the Little Blackfoot Pass. (Panorama labeled "Stanley, Del. after Sohon.") (Following p. 184.)
Kamas Prairie of the Pend d'Oreilles, in the Rocky Mountains, Looking Southward. (Following p. 184.)
View of the Clark's Fork and the Ridge of Mountains, South of the Flathead Lake, Looking Eastward. (Following p. 184.)
Source of the Peluse. (Labeled "Stanley, Del. after Sohon.") (Facing p. 200.)
Big Blackfoot Valley. (Facing p. 214.)
Crossing the Hellgate River, Jan. 6, 1854. (Following p. 244.)

COLORED LITHOGRAPHS AFTER SOHON DRAWINGS PUBLISHED IN "REPORT ON THE CONSTRUCTION OF A MILITARY ROAD FROM FORT WALLA WALLA TO FORT BENTON," BY CAPT. JOHN MULLAN, U.S.A. WASHINGTON, D. C. 1863. (Processed by "Bowen & Co. Lith. Philada.")

- Military Post & City of Walla Walla, W. T. in 1862. (First frontispiece.)
Fort Benton—Head of Steam Navigation on the Missouri River. (Second frontispiece.)
Cantonment Stevens—Capt. Mullan's Winter Quarters 1853-4. (Facing p. 2.)
Coeur d'Alene Mission in the Rocky Mountains. (Facing p. 16.)

- Paloose Falls in Washington Territory. (Facing p. 28.)
 Cantonment Wright—Capt. Mullan's Winter Quarters in 1861-2.
 (Facing p. 32.)
 Upper Falls of the Missouri River. (Facing p. 48.)
 Mode of Crossing Rivers by the Flathead and other Indians. (Facing
 p. 50.)
 Pend d'Oreille Mission in the Rocky Mountains in 1862. (Facing
 p. 52.)
 Great Falls of the Missouri, 2500 miles from St. Louis. (Facing
 p. 54.)
- HALFTONE REPRODUCTIONS OF SOHON DRAWINGS PUBLISHED IN "THE LIFE
 OF ISAAC INGALLS STEVENS," BY HIS SON HAZARD STEVENS. TWO vols.
 Houghton, Mifflin and Company, Boston and New York, 1900.
- Low Horn, Piegan Chief. (Facing p. 374, vol. 1.)
 The Arrival of the Nez Percés. (Facing p. 34, vol. 2.)
 Feasting the Chiefs. (Facing p. 36, vol. 2.)
 Kam-i-ah-kan, Head Chief of the Yakimas. (Facing p. 38, vol. 2.)
 Spotted Eagle, a chief of the Nez Percés. (Facing p. 40, vol. 2.)
 Walla Walla Council. (Facing p. 42, vol. 2.)
 Pu-pu-mox-mox: Yellow Serpent, Head Chief of the Walla Wallas.
 (Facing p. 46, vol. 2.)
 We-ah-te-na-tee-ma-ny: Young Chief, Head Chief of the Cuyuses.
 (Facing p. 50, vol. 2.)
 She-ca-yah: Five Crows, Cuyuse Chief. (Facing p. 52, vol. 2.)
 Looking Glass, War Chief of the Nez Percés. (Facing p. 54, vol. 2.)
 Hal-hal-tlos-sot: The Lawyer, Head Chief of the Nez Percés.
 (Facing p. 58, vol. 2.)
 The Scalp Dance. (Facing p. 60, vol. 2.)
 Ow-hi, a Chief of the Yakimas. (Facing p. 64, vol. 2.)
 The Flathead Council. (Facing p. 112, vol. 2.)
 Blackfoot Chiefs—Star Robe, The Rider, Heavy Shield, Lame Bull.
 (Four individual portraits.) (Facing p. 114, vol. 2.)
 Tat-tu-ye. The Fox, Chief of the Blood Indians. (Facing p. 116,
 vol. 2.)
 Mek-ya-py, Red Dye, Piegan Warrior (Facing p. 116, vol. 2.)
 Commissioner Cumming and Interpreters. James Bird, Delaware
 Jim, Colonel Alfred Cumming, William Craig, Alexander
 Culberston. (Five individual portraits.) (Facing p. 118, vol. 2.)
 Crossing the Bitter Roots in Midwinter. (Facing p. 126, vol. 2.)
 Coeur d'Alene Mission. (Facing p. 128, vol. 2.)
 Spokane Garry, Head Chief of the Spokanes. (Facing p. 140, vol. 2.)
 Ume-how-lish, War Chief of the Cuyuses. (Facing p. 148, vol. 2.)





SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 110, NUMBER 8

Roebling Fund

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THE BEHAVIOR OF BAROMETRIC PRESSURE DURING AND AFTER SOLAR PARTICLE INVASIONS AND SOLAR ULTRAVIOLET INVASIONS¹

BY B. DUELL AND G. DUELL

GENERAL CONSIDERATIONS

A convincing proof that there exists an influence on the large-scale weather course, exerted by certain radiation invasions that are connected with increased sun activity, would be of theoretical interest for the geophysicist and also of practical importance for the meteorologist who is in charge of the daily weather forecast. In a great number of statistical investigations an attempt has been made to furnish that proof. In these statistics monthly and annual mean values of single meteorological elements have been correlated with corresponding mean values of the relative sunspot numbers and sometimes of the solar constant. Less frequently daily values of the quoted elements have been correlated with each other, e.g., by C. G. Abbot (1), H. Arctowski, (2), H. H. Clayton (3), E. Huntington (4), V. M. Rubashev (5), and others. Only rarely has an attempt been made to use other character numbers for the kind and intensity of the eruptive sun activity, although such data, e.g., the profile numbers for prominences, details about photospheric faculae, calcium flocculi, bright and dark hydrogen flocculi, bright chromospheric eruptions and characteristic brightenings of the solar corona, have been available for quite a number of years. Also the different kinds of geomagnetic character figures, systematic observations of the aurora borealis, and certain direct ionospheric multifrequency-recording data, by which different disturbed states of the D-, E-, F₁-, and F₂-layers are characterized, have been largely disregarded, when the possibility of solar influences on the troposphere was examined statistically.

¹ Paper read before a joint meeting of the American Physical Society and the American Meteorological Society on May 1, 1947, at Washington, D. C.

METHODS

The investigations, of which we shall describe on the following pages only a few results, are characterized by a strict distinction and completely separate statistical treatment of those different kinds of solar-radiation eruptions which are known to influence the ionosphere. All computations were made exclusively on the basis of daily values of the solar, ionospheric, and meteorological elements. The method used throughout the whole work was the so-called "superposed-epoch" method. The application of this method takes place as follows: At first a certain number of well-defined key dates are selected from a series of observations, as long as possible, of that element (e.g., geomagnetic activity), which is regarded hypothetically as controlling another element. Then a mean value "n" is obtained by averaging arithmetically all those values of the element, assumed as controlled (e.g., sea-level air pressure), which belong to these key days. The same process is repeated for several days which precede the key days ("n-1," "n-2," etc.) and for several days which follow the key days ("n+1," "n+2," etc). In such a way there is obtained the typical average behavior—free from the accidents of the individual case—of the chosen meteorological element, before, during, and after the time of the solar or ionospheric event which is assumed to control this element. From this description it can be seen that the "superposed-epoch" method is a simplified correlation method which has the advantage that it is applicable to the most widely varying forms of correlations without modification. Random variations are eliminated automatically by this method, if the number of key days is sufficiently high. A criterion of reality consists in dividing the whole statistics in parts of equal size, e.g., even years and odd years, summer and winter, and comparing the resulting average curves of these parts with each other. The selection of the key days is often done by taking the five highest and the five lowest values of every month.

I. RELATIONSHIP BETWEEN SOLAR PARTICLE INVASIONS AND SEA-LEVEL PRESSURE

A. ORIGIN OF PARTICLE INVASIONS AND OF IONOSPHERIC STORMS

The particle invasions are generated by eruptive processes in the so-called M-regions of the sun (J. Bartels (6)). They are not closely connected with sunspots, photospheric faculae, bright chromospheric flocculi or plages, or bright chromospheric eruptions or solar flares. The earth is affected by these invasions only if the place of the M-

regions is situated in the vicinity of that point where the line connecting the center of the sun with the center of the earth crosses the sun's surface. The radiation emitted from these regions, causes a characteristic brightening of certain coronal emission lines, especially 5303 and 5694 Å. The intensity of these lines can be measured with the coronagraph if the M-regions are situated at the east or west limb of the sun. With the assistance of such intensity measurements of the mentioned corona lines, it will not be impossible to forecast particle invasions and accordingly also ionospheric storms, for the life duration of these M-regions amounts to several weeks, and sometimes even months (J. Bartels (6), M. Waldmeier (7)), the velocity of the solar particles can be determined with the aid of special methods, and the rotation velocity for the respective solar zones is known.

An ionospheric storm is particularly characterized by a considerable decrease of the equivalent electron density in the so-called F-layer. Frequently the behavior of the F-layer during an ionospheric storm has been compared with an expansion, because at the same time there can be observed an essential increase in height of the layer, and temporarily there appear diffuse reflections from heights which exceed the normal height by several hundred percent. In fact, very often the "fixed-frequency" height records give the impression that the whole F-layer is blown asunder. Frequently the occurrence of ionospheric storms is connected with the appearance of irregular geomagnetic disturbances or "magnetic storms" at approximately the same time.

B. STATISTICAL RESULTS

As direct observations of the frequency and intensity of ionospheric storms were not available for the period 1906-1937, covered by this part of our investigation, we had to use instead of these missing data the rather reliable figures of the geomagnetic activity. Fitted for our purpose were the international character figures for terrestrial magnetic conditions which are averaged from the observations of about 50 observatories and regularly published by the International Union of Geodesy and Geophysics, Section of Terrestrial Magnetism and Electricity. The use of 5 particularly disturbed and 5 particularly quiet days in each month, selected by the Royal Meteorological Institute of the Netherlands (in De Bilt), can be justified by the advantage that, after dividing the whole statistics arbitrarily into periods of equal length, each part contains an equal number of key days. Such a subdivision has been accomplished by considering separately: years with high sun activity, where the annual mean of the relative sun-

spot number is >40 , and years with low sun activity, where the annual mean of the relative sunspot numbers is ≤ 40 ; the years with even and the years with odd numbers; and, finally, the different seasons. In the pursuit of similar geophysical investigations, e.g., those performed by J. M. Stagg (8), we divided the year in three parts, as follows: winter (November, December, January, and February), spring+autumn (March, April, September, and October), and summer (May, June, July, and August).

The sea-level pressure data used in that part of the investigation were observed during an uninterrupted series of 11,688 single days. The beginning on January 1, 1906, and the end on December 31, 1937, of that series were established by the fact that for the time before January 1, 1906, there were not available sufficiently reliable geomagnetic character numbers, and for the time after December 31, 1937, there were not yet published daily mean values of sea-level pressure for the stations that we used.

As a very detailed elaboration of the data from Potsdam (Germany) and Stykkisholm (Iceland) had revealed that a conspicuous relationship between ionospheric storms and sea-level pressure could be demonstrated only for the years with low sun activity, when r is ≤ 40 , and even then only during the winter months, the studies were confined to the 16 years with low sun activity (1910-1914, 1920-1924, and 1930-1935) and to the winter months November, December, January, and February. In addition to the above-mentioned, the data of eight further stations were investigated. These places (De Bilt, Karlsruhe, Vienna, Breslau, Königsberg, Warsaw, Lemberg, and Kiev), as well as Potsdam, are all situated within the zone 45° to 55° N. latitude and 5° to 30° E. longitude. Computed by means of the superposed-epoch method, figure 1 shows for these stations the average behavior of sea-level pressure as related to all those days (320) when the ionosphere was particularly disturbed, and to all those days (320) when the ionosphere was particularly undisturbed. Besides this, the curves demonstrate the average behavior of sea-level pressure on those 3 days which precede the key days, and on those 11 days which follow the key days. It can be seen from figure 1 that at all stations the sea-level pressure is lower than normal after the days when the ionosphere is particularly disturbed, with a minimum value 3 days after, and higher than normal after the days when the ionosphere is particularly undisturbed, with maximum value 3 to 4 days after. The different behavior of sea-level pressure after ionospheric storms and after ionospheric calms is especially clearly demonstrated by means of difference curves, "disturbed minus undisturbed," which

are shown in figure 2. The maximum difference on the third to fourth day after the key dates amounts to 2.6 to 3.2 mb., varying according to the geographical position of the station. Additional evidence for the reality of the relationship is found if these statistics are subdivided arbitrarily according to even and odd years or according to other points of view. Curves representing these completely independent arrangements of the different parts are extremely similar. This is true for all stations which were examined. For want of space, however, only one example is presented in figure 3.

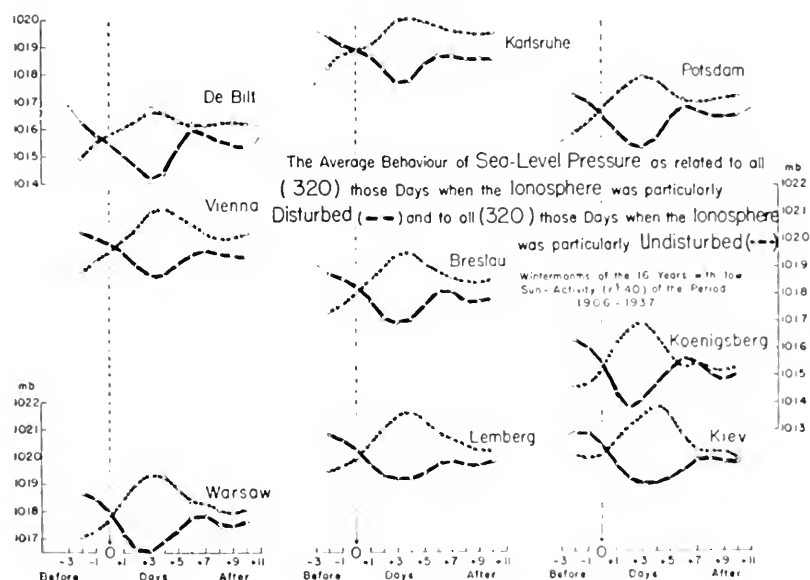


FIG. 1.

To find out more about the kind of relationship between the state of the ionosphere and the behavior of sea-level pressure, the number of stations to be included in this investigation was increased to 26. As far as the respective data were available for such a long series of years, the stations were selected in such a manner that the final results could be represented synoptically. The following stations could be used for that purpose: (from N. to S.) Vardoe, Haparanda, Stykkisholm, Trondhjem, Lerwick, Oslo, Leningrad, Stockholm, Moscow, Copenhagen, Königsberg, Potsdam, Valentia, De Bilt, Warsaw, Breslau, Kiev, Lemberg, Karlsruhe, Brest, Vienna, Bucharest, LaCoruña, Marseille, Sofia, and Rome. Figure 4 shows the average normal sea-level pressure distribution (mb.) over Europe during the

winter months November, December, January, February in the 16 years with low sun activity, when r is ≤ 40 . The pressure is low with 997.7 mb. over Iceland-Jan Mayen, and high over Rumania with 1021.7 mb., as well as over Spain with 1019.8 mb. Pressure gradients run from SE. and S. to NW. Let us consider now all those 320

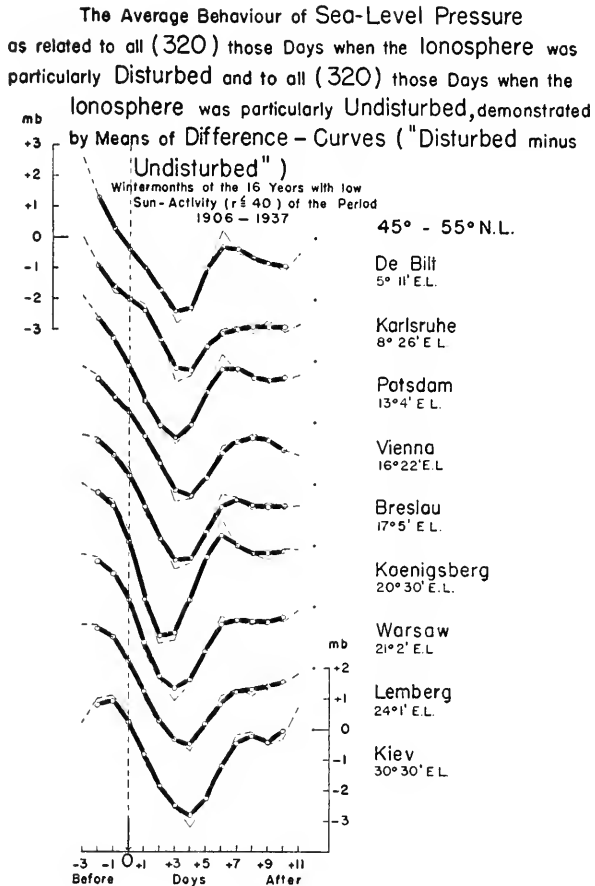


FIG. 2.

days when the ionosphere was particularly disturbed, during the winter months, in the years with low sun activity. In figure 5, a synoptical representation is given of the average departures of the sea-level pressure field from the long-period means, 1 day before these disturbed days. There are no considerable sea-level pressure differences on this map. The maximum pressure difference within this pressure field amounts only to 1.2 mb. Figure 6 shows the same conditions

for the disturbed days themselves. On this map, too, no significant pressure differences are discernible. The picture is dominated by a zero isoline, which covers nearly the whole European continent. The greatest pressure difference within this pressure field is only 1.6 mb. Quite another picture is demonstrated by figure 7, which shows the same conditions as the preceding figures, but for the first day after the disturbed days.

The Average Behaviour of Sea-Level Pressure
as related to all (320) those Days when the Ionosphere was
particularly Disturbed and to all (320) those Days when the
Ionosphere was particularly Undisturbed, demonstrated
by Means of Difference - Curves ("Disturbed minus
Undisturbed")

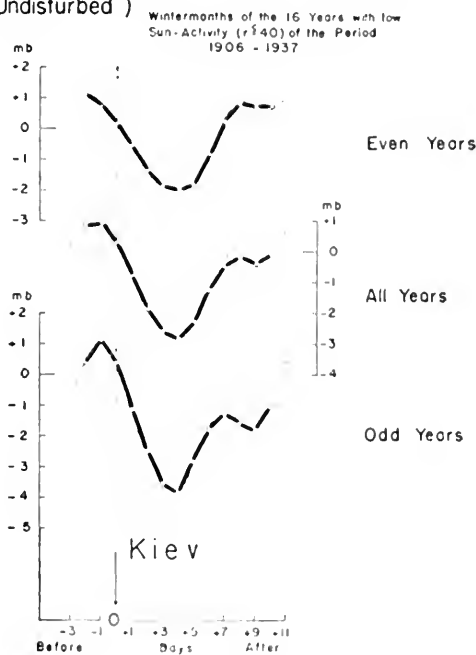


FIG. 3.

A considerable gradient with a maximum pressure difference of 3.7 mb. has been built up over the North Atlantic, in the direction NW. to SE. There is a plus-area over Iceland of + 2.1 mb. and a minus-area over the Gulf of Bothnia of - 1.6 mb. The direction of this additional gradient is such that the normal average gradient, as computed from long-period means (see fig. 4), is flattened by it. In figure 8 we see the average additional sea-level pressure field 2 days after ionospheric storms. The pressure gradient, directed from

NW. to SE., has become still more steep and has reached the relatively high value of 5.0 mb. The anomalous plus area of +2.5 mb. is situated over Iceland and the Strait of Denmark as before. The area with positive departures ≥ 2.0 mb. is covered with little crosses. The minus area of -2.5 mb. has shifted a little toward the SE., and is now situated over the Baltic States. The area with negative departures ≥ 2.0 mb. is cross-hatched with horizontal lines. The beginning of a flattening of this ionosphere-controlled sea-level pressure field can

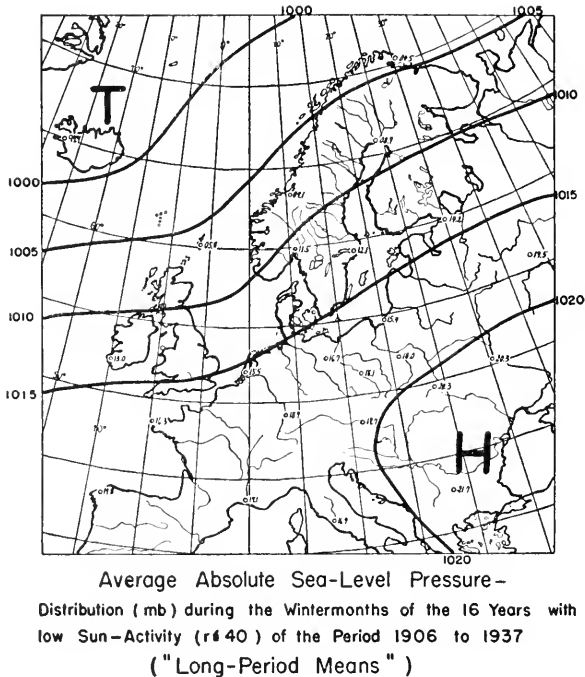
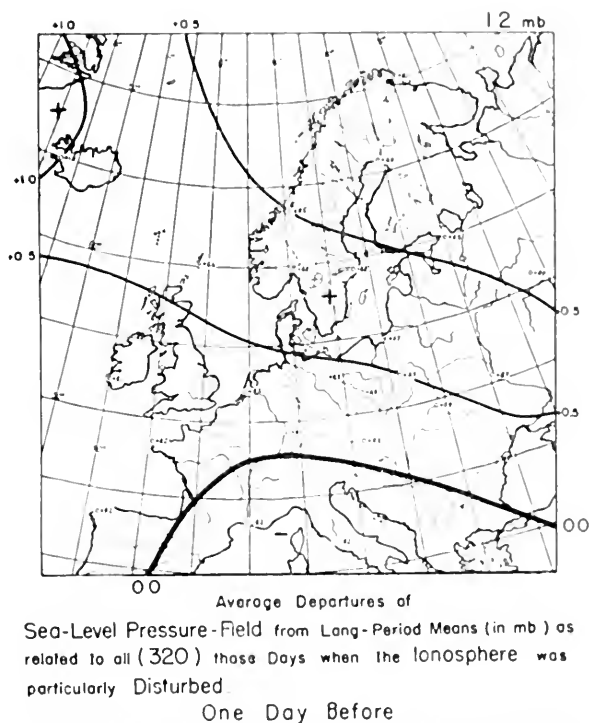


FIG. 4.

be recognized as early as 3 days after the ionospheric storms in figure 9. The plus-area (with +2.0 mb.) has shifted somewhat toward E., and the minus-area, with extreme values diminished to -1.7 mb., has broken up into two parts, during displacement toward the S. The greatest pressure difference is only just 3.7 mb.

Figure 10, representing the situation 4 days after the ionospheric storms, and figure 11, showing these conditions 5 days after, demonstrate how the flattening of the additional pressure field progresses slowly but steadily, with maximum gradients of 3.3 and 3.1 mb. From figure 12, 6 days after, it can be seen that the plus-area with

+1.8 mb. has shifted somewhat toward the S., and is now situated over the middle part of Scandinavia. Remaining parts of the minus-area (with -0.9 and -0.7 mb.) are only just slightly discernible. The maximum gradient has been reduced to 2.7 mb. Figure 13, 7 days after, begins to show an approach to the neutral initial state. Any noteworthy gradient can no longer be recognized there. The greatest difference between positive and negative departures of the pressure



Wintermonths of the 16 Years with low Sun-Activity (r < 4.0) of the Period 1906-1937

FIG. 5.

from the normal distribution amounts to 1.8 mb. Finally, in figure 14, 8 days after, gradients no longer exist—only a completely irregular and insignificant distribution of very flat positive and negative pressure anomalies. The maximum difference between them is not greater than 1.4 mb. This is nearly the same value as on the days before the disturbed days, at the beginning of the whole development. In just the same manner as there, the picture is dominated by a zero isoline, which, in the form of an unbroken curve, covers a great part of Europe. Figure 15 represents the average behavior of the max-

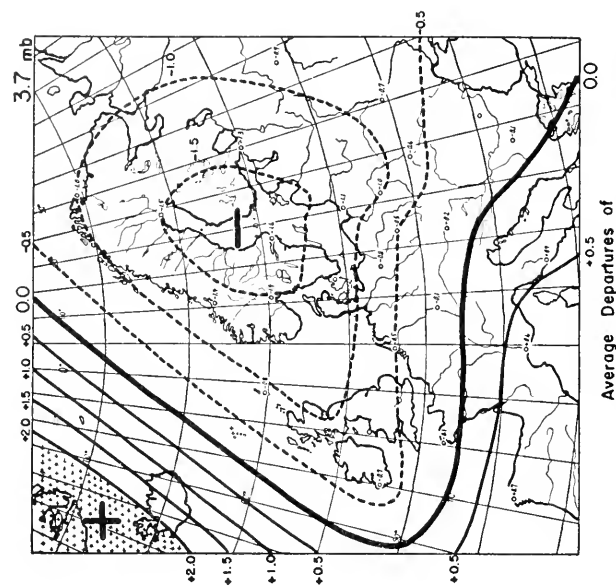


FIG. 6.

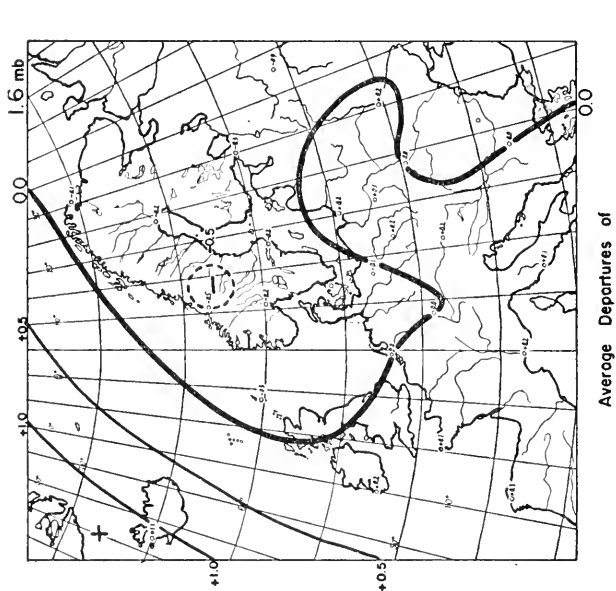
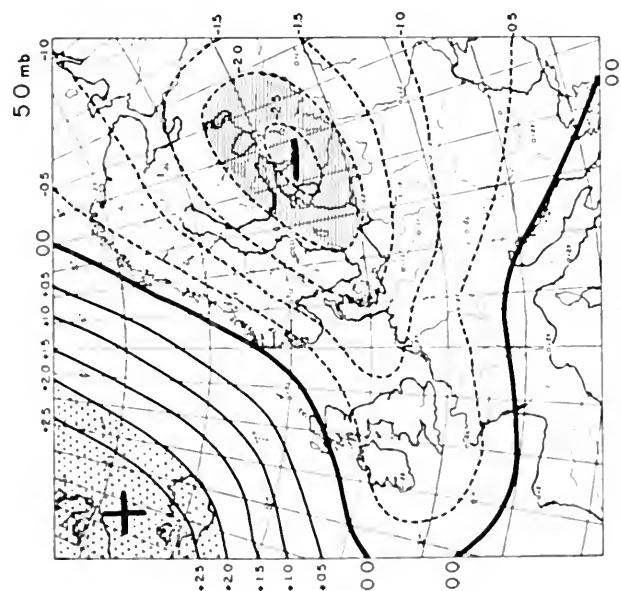


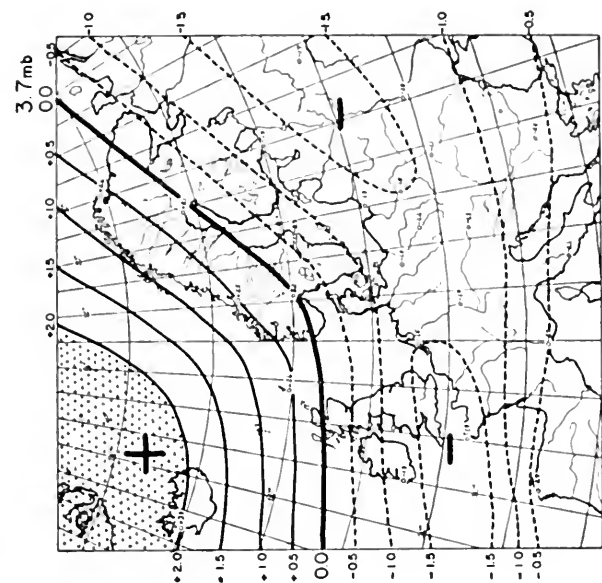
FIG. 7.



Average Departures of
Sea-Level Pressure-Field from Long-Period Means (in mb) as
related to oil (320) those days when the ionosphere was
particularly Disturbed
Two Days Later

Wintertime of the 16 Years with low Sun-Activity (1840) of the Period 1906-1937

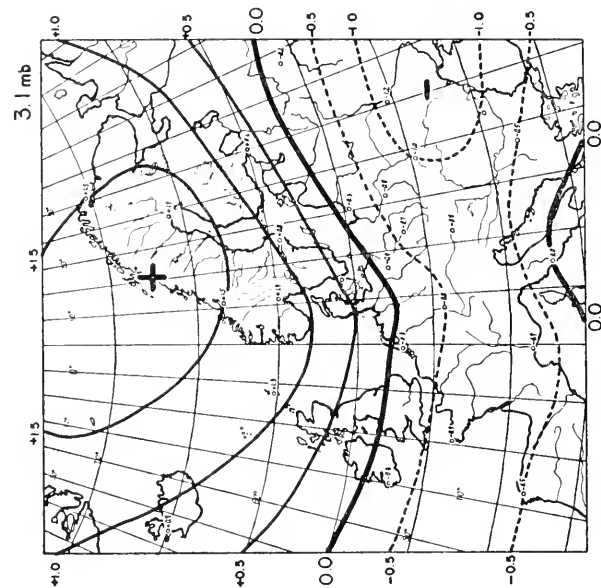
FIG. 8.



Average Departures of
Sea-Level Pressure-Field from Long-Period Means (in mb)
as related to oil (320) those days when the ionosphere
was particularly Disturbed.
Three Days Later

Wintertime of the 16 Years with low Sea-Activity (1840) of the Period 1906-1937

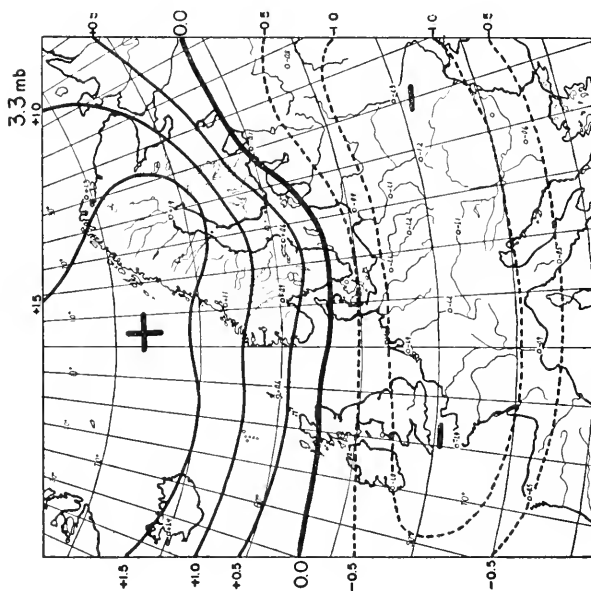
FIG. 9.



Average Departures of
 Sea-Level Pressure-Field from Long-Period Means (in mb)
 as related to all (320) those Days when the Ionosphere
 was particularly Disturbed.
 Five Days Later

Wintermonths of the 16 Years with low Sun-Activity ($r \leq 40$) of the Period 1906-1937

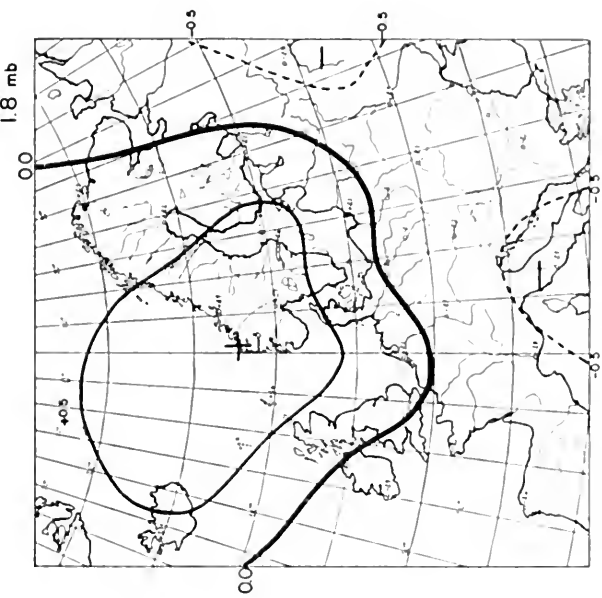
FIG. 11.



Average Departures of
 Sea-Level Pressure-Field from Long-Period Means (in mb)
 as related to all (320) those Days when the Ionosphere
 was particularly Disturbed.
 Four Days Later

Wintermonths of the 16 Years with low Sun-Activity ($r \leq 40$) of the Period 1906-1937

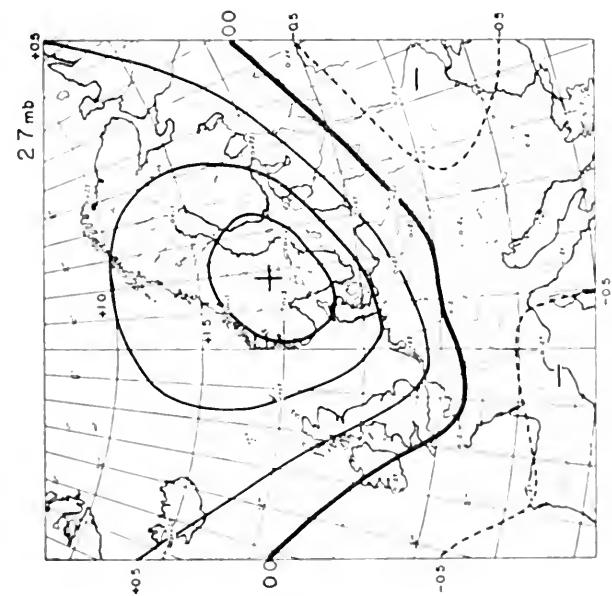
FIG. 10.



Average Departures of
Sea-Level Pressure-Field from Long-Period Means (in mb)
as related to all (320) those Days when the Ionosphere
was particularly Disturbed
Seven Days Later

Wintertime of the 16 Years with low Sun-Activity (1.40) of the Period 1906-1937

FIG. 13.

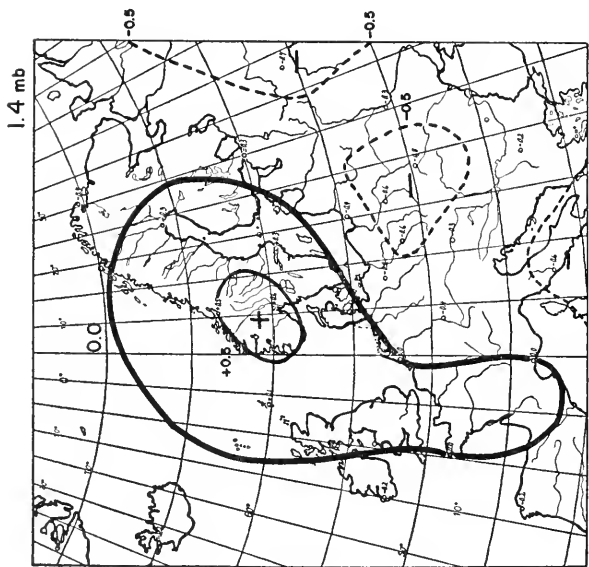


Average Departures of
Sea-Level Pressure-Field from Long-Period Means (in mb)
as related to all (320) those Days when the Ionosphere
was particularly Disturbed
Six Days Later

Wintertime of the 16 Years with low Sun-Activity (1.40) of the Period 1906-1937

FIG. 12.

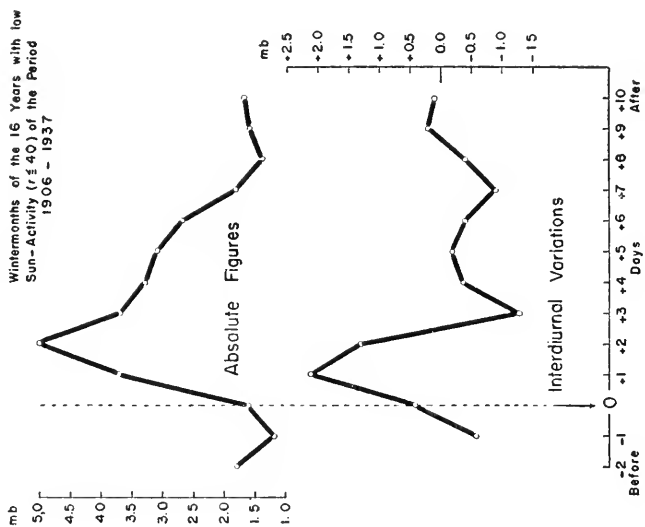
The Average Behaviour of the Maximum Gradient of the Additional Sea-Level Pressure-Field (Departures from Long-Period Means, in mb) as related to all (320) those Days when the Ionosphere was particularly Disturbed.



Average Departures of Sea-Level Pressure-Field from Long-Period Means (in mb) as related to all (320) those Days when the Ionosphere was particularly Disturbed.
Eight Days Later

Wintertime of the 16 Years with low Sun-Activity ($r \leq 40$) of the Period 1906-1937

FIG. 14.



Wintertime of the 16 Years with low Sun-Activity ($r \leq 40$) of the Period 1906-1937

FIG. 15.

imum gradients of the additional sea-level pressure field after ionospheric storms in a very condensed form. As can be seen from the upper curve, the greatest increase of the gradient, from 1.6 to 3.7 mb., takes place as early as the first day after the ionospheric storms. However, the absolute peak of 5.0 mb. is reached only on the second day after the disturbed days. Then occurs a decrease of 1.3 mb. to the "third day after," and from that time a gradual decrease until, on the "eighth day after," the low value of 1.4 mb. is reached. The lower curve of the same figure shows the interdiurnal variation of the gradient, and accordingly has its peak, with + 2.1 mb., on the first day after the ionospheric storms.

As has been emphasized above, this relatively clear relationship between the invasions of solar particles and the behavior of sea-level pressure can be demonstrated only for the winter months and, even then, only for the years with low sun activity. This fact cannot yet be explained in a really satisfactory manner. However, we shall enter briefly into this question when we discuss the manner in which solar-activity influences are transmitted to the troposphere. Here attention can only be called to the fact that other authors, working with similar statistics and subdividing these, also obtained very different results for the different seasons as well as for the years with high and with low sun activity. Some few examples will make this evident: A. Peppler (9) found, by using monthly mean values, that there has been a positive correlation since 1906 between the relative sunspot numbers and the course of sea-level pressure anomalies over the Atlantic in the zone between 60° and 70° N. latitude, and a negative correlation when the zone between 25° and 35° N. latitude was considered. When subdividing his statistics according to the different seasons, he found that relationship well developed during the winter, but could not discover it during the summer and autumn. J. M. Stagg (8) found that in Lerwick on days with geomagnetic disturbances, the forenoon maximum of the diurnal variation of sea-level pressure was lower, and the afternoon maximum was higher, than on days without geomagnetic disturbances. This relationship was likewise particularly evident in the years with low sun activity. O. Krogness (10) has found that a 27-day period, caused by the sun rotation in some meteorological elements in the northern part of Norway, could be observed regularly in the years with low sun activity.

C. ATTEMPT AT A PHYSICAL EXPLANATION OF THE OBSERVED RELATIONSHIP

In the following chapter will be described an attempt at a schematic description of the manner in which the influence of short- and long-duration eruptions of those solar particles which leave the sun is transmitted to the troposphere. We are convinced that this explanation is incomplete and will go through important modifications in the future.

The places of formation of these eruptions of electrically charged and uncharged solar particles (negatrons, protons, neutrons, alpha particles, as well as Na-, Ca-, Mg-, and other atoms) which leave the sun, the so-called M-regions, are situated within the "king zones" (between 40° N. latitude and 40° S. latitude). Some of the best-known solar phenomena that attend this kind of eruption are: (1) a considerable strengthening of certain corona lines, especially 5303 and 5694 Å., and (2) certain kinds of prominences. The effects of these particles are partly localized, both on the dark and sunlit earth hemispheres. The best known of the consecutive geophysical reactions to these particle invasions are "ionosphere storms," auroras, geomagnetic storms, disturbances of the electric earth-current system, and a special kind of irregular, long-duration fading of short radio waves. Being absorbed, the particles deliver to the high atmosphere their kinetic energy $\frac{mv^2}{2}$, which—because of their high

velocity: $v \sim 2 \times 10^8 \frac{\text{cm.}}{\text{sec.}}$ —is not inconsiderable. The main resulting consequences are: A pressure effect in the direction of the shocks; ionization; excitation of the emission of visible light-, ultraviolet-, and X-ray-photons; dissociation, especially of the molecular oxygen; production of chemical compounds in form of condensation nuclei; and heating of the absorbing layer. Moreover, an electrical polarization of the high atmospheric layers may be expected, because of the segregation by the geomagnetic field of those portions of the particles with positive and negative electric charges, and because of the different heights of the absorbent layers for the positive protons and alpha particles, and the negative electrons, according to their different mass and velocity.

As to the magnitude of the shock-pressure effect that may be expected, no details have hitherto been known. The dissociation of the oxygen molecules must be accompanied by a considerable increase in pressure, provided there is available a sufficiently great amount of molecular oxygen. This condition may be fulfilled much less in sum-

mer and in years with high sun activity, and also after many ultra-violet invasions, than in winter and in years with low sun activity. Perhaps that is one of the reasons for the fact that an influence of the particle invasions on sea-level pressure could be demonstrated only for winter and for years with low sun activity. The heating of those layers which absorb the particles is likewise not inconsiderable, as has been shown by theoretical considerations and by computations of H. Petersen (11). R. M. Deeley (12) regards this heating as a sufficient cause for the decreases of sea-level pressure which he observed in Arctic regions during the culmination of solar-activity centers.

An electric polarization of the high atmospheric layers, the probability of which has been stressed by several authors, could be important for several reasons. In the first place electroconvective processes, i.e., "ion winds," could follow such polarization. It has been proved experimentally by V. F. Hess (13) that these ion winds are connected with relatively strong dynamic effects. In the second place, a penetration into the troposphere of the lines of equal force originating in the ionospheric-electric field is possible under certain circumstances (J. Scholz (14)). In that case the colloidal stability of clouds, and therefore the size of droplets and the precipitation tendency, may be influenced (A. Schmauss and A. Wigand (15)). Furthermore, there is a possibility that certain chemical compounds, and consequently condensation nuclei, are produced by electric discharges between the polarized layers. However, such chemical compounds may be produced also during the ordinary bombardment by solar particles of the oxygen-nitrogen mixture, especially in the presence of water vapor or hydrogen. Such particles, e.g., protons, are furnished by the solar particle invasions themselves. This possibility of formation of ammonium nitrate and ammonium nitrite-condensation nuclei by solar particles, especially by electrons, has been emphasized particularly by P. Lenard (16). Industrial processes in the course of which ammonia is produced by the action of electrons upon a mixture of nitrogen and hydrogen are known (Buch-Anderesen (17)).

The numerous observations of a coincidence between the appearance of intensive auroras and the sudden formation of cirrus clouds (H. Fritz (18), H. J. Klein (19), E. Thienemann (20), A. Paulsen (21)) likewise seem to point to the origin of condensation nuclei during particle invasions. Further support for that hypothesis was given by G. Archenhold (22), who could demonstrate that there is a certain probability for the geomagnetic character figure being higher on days with sun halos than it would be on ordinary days.

To explain that relationship, Archenhold points to the possibility that solar neutrons, because of their special qualities, penetrate much deeper into the earth atmosphere than do the solar alpha particles, protons, and negatrons. Only in those layers which contain a sufficient amount of water vapor, e.g., in the cirrus level, would they undergo a considerable retardation, and even absorption. A necessary provision for the occurrence of condensation phenomena would in all such cases be the presence of an atmospheric layer saturated with water vapor and relatively free from other condensation nuclei. As has been shown on different occasions, these conditions occur not infrequently (A. Schmauss and A. Wigand (15)). Even then, if the neutron hypothesis could not stand the test, there would be a possibility of explaining the presence of solar-produced condensation nuclei in the upper troposphere. According to the investigations of H. Petersen (23), E. Palmén (24), and A. Refsdal (25), a drop of the tropopause produces a cyclonal circulation. This flow may continue up to the high stratosphere and may suck down air from there in the center of the cyclone. This is possible because the kinematic viscosity of air in the tropopause level is very small, according to Chapman and Milne, and only in heights of about 60 km. again reaches the sea-level value. In that scheme there is considered the important fact discovered by Palmén in 1932 that the upward movement of the air in the cyclone and the downward movement in the anticyclone are confined to the lower and middle troposphere, and that the vertical movements in the upper troposphere and in the stratosphere have the opposite direction.

The assumption of a separate existence of the troposphere, independent of the stratosphere, had been definitely destroyed by these findings. A down-transportation of condensation nuclei might be possible in such a way, and the question now arises, to what extent could an additional supply of condensation nuclei act upon the tropospheric processes? As is known, the liberated condensation heat inheres into the water droplets themselves, and, as the expansion of fluids compared with that of gases is extremely small, the temperature increase becomes evident only when the energy has been transmitted to the surrounding air. This energy transfer is performed much faster if a certain amount of water vapor condenses into many small rather than into a few large droplets. In such a way, according to C. Braak (26), a greater number of nuclei can accelerate the transformation of condensation heat into intensified convection.

A local turbidity of the stratosphere, produced by nuclei, can become important even without any condensation phenomena, because

it may give rise to regionally intensified heat emission of the stratosphere, which, according to G. Stueve (27), may cause the development of independent islands of high air pressure. According to S. P. Chromov (28), transformations of the large-scale weather situation may be produced by such processes.

Figure 16 gives a concentrated summary of the different hypotheses which have been postulated to explain the effect of solar particle invasions upon the stratospheric-tropospheric circulation and large-scale weather situation. An evaluation of such effects should never be undertaken without regarding the fact that the result of these influences will always, in a high measure, depend on the initial state of the troposphere and on the amount of potential energy which is available for release by ionospheric-stratospheric processes. It is quite possible that the effect of a particle invasion at one time will remain without any consequences, and on another occasion, when all involved factors stand in an optimal proportion to each other, will give rise to a complete change in the large-scale weather situation. Furthermore, it is probable that the occurrence frequency and the kind of succession of such particle invasions, and, in addition, the interfering appearance of ultraviolet invasions, will be of decisive importance for the efficiency of each single particle invasion.

II. RELATIONSHIP BETWEEN SOLAR ULTRAVIOLET INVASIONS AND SEA-LEVEL PRESSURE

A. ORIGIN OF SOLAR ULTRAVIOLET INVASIONS

Solar ultraviolet invasions occur during bright chromospheric eruptions. These appear generally in connection with certain sunspot groups, at the outer margin of the penumbrae. The number and intensity of the eruptions depend closely on the type and phase of development of the sunspot groups. The international indices for the intensity ("1," "2," and "3") correspond to an average life duration of 20, 40, and 60 minutes and to average areas of 1.2×10^{-4} , 3.8×10^{-4} , and 10.2×10^{-4} fractions ($\sim 1:3:9$) of the apparent sun disk. The brightness generally increases with the size of the eruption. The wave radiation of these eruptions consists chiefly of the emission lines of hydrogen, helium, and calcium. It has been possible to conclude from the results of prominence research and ionosphere research that the intensity of this ultraviolet radiation per unit of the eruption area is about 10^8 times as strong as that ultraviolet intensity which has been computed on the basis of Planck's radiation formula for the same spectral range and for an undisturbed sun. By these proc-

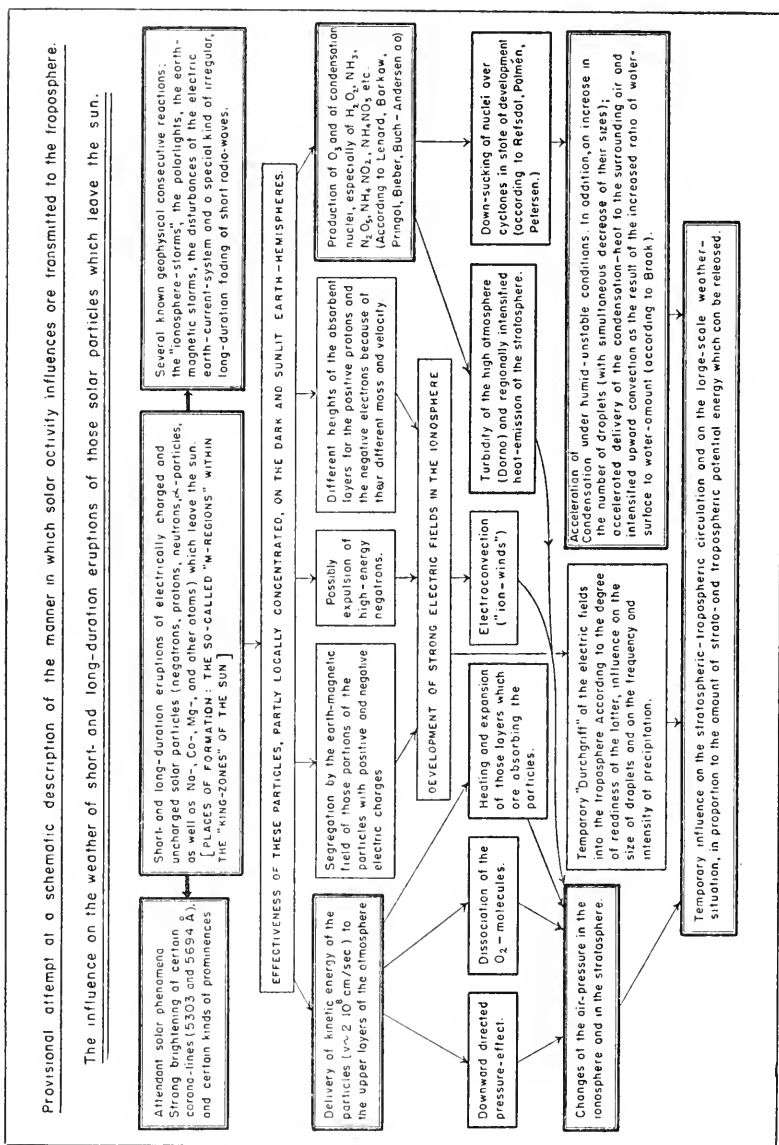


FIG. 16.

esses alone the total ultraviolet radiation of the whole sun surface is raised by several hundred percent. The total radiation of the sun in the whole spectral range is raised only by several percent. However, even these few additional percent are not included in the direct measurements involved in the "solar constant," generally measured on high mountains, because this part of the ultraviolet has already been absorbed in the ionosphere and stratosphere. They are but imperfectly allowed for by estimates of unmeasured ultraviolet wavelength response. Bright chromospheric eruptions are not observed in heliographic latitudes higher than 40° .

B. STATISTICAL RESULTS

All chromospheric eruption data used for our statistics have been collected by the sun-control service established by the International Astronomical Union with the help of spectrohelioscopes and spectroheliographs, and have been published, after a detailed examination and compilation by L. d'Azambuja (Meudon), in the Bulletin for Character Figures of Solar Phenomena of the Eidgenoessische Sternwarte in Zürich (Switzerland).

As key dates, there have been selected all those days of the period January 1, 1936, to December 31, 1941, on which (between 0900 and 1500 G.M.T.) bright chromospheric eruptions of the intensity "2-3" and "3" had been observed, provided they were not preceded on the previous 5 days by equally strong eruptions. The limitation to 6 years was made necessary by the fact that there do not exist sufficiently complete eruption observations for the time before 1936, and that for the time after 1941, no such data had been published at the beginning of our investigation.

Figure 17 shows the average behavior of sea-level pressure (1300 G.M.T.) at the stations Hamburg, Frankfurt a.M., and Vienna on all 51 days with strong ultraviolet invasions as defined above, and also on 1 preceding and 11 following days. The applied method, already described in detail, is the same as for figures 1 to 15. At all these stations a very distinct maximum of sea-level pressure appears 4 to 6 days after the ultraviolet invasions. Surprising is the fact that this maximum, and even the other part of the curve course, has almost the same form in the summer months April to September as in the winter months October to March. The amplitudes of these curves are at all three stations greater in the winter (3.4 mb. in Hamburg, 4.0 mb. in Frankfurt a.M., and 3.0 mb. in Vienna) than in the summer (2.6 mb. in Hamburg, 2.6 mb. in Frankfurt, and 1.7 mb. in Vienna).

The great similarity between the summer curves and the winter curves represents a criterion of reality which should not be underestimated, because the summer and winter months are completely independent of each other in these statistics where only daily values were used to investigate short-term impulselike solar influences. Figure 18 shows the average behavior of the maximum, interdiurnal increases in sea-level pressure, occurring within the preceding 24 hours over the area 45° to 60° N. latitude and 10° W. longitude to 20° E. longitude on all days with very intense ultraviolet invasions, and moreover on 1 preceding and 8 following days. The respective mete-

The Average Behaviour of Sea-Level Pressure (1300 GMT)
as related to all (51) very Intense Ultraviolet Radiation - Invasions (BETWEEN
0900 AND 1500 GMT) which were not preceded on the previous 5 Days by equally
strong Invasions.

1936 - 1941

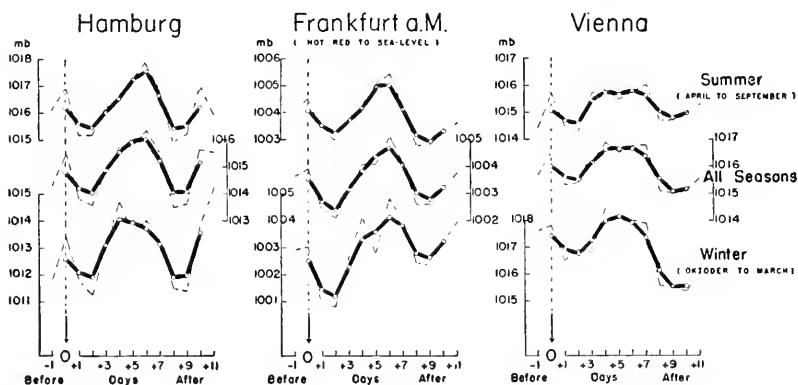


FIG. 17.

orological data were taken out of the daily isallobaric maps, published in the *Täglicher Wetterbericht* by the Deutsche Seewarte in Hamburg. For this representation a subdivision was undertaken, not only in summer and winter, but also in years with increasing sun activity (1936-1938), and in years with decreasing sun activity (1939-1941). Even here the great similarity of the curves with each other is striking, and the more important because the groups of years and seasons are again completely independent of each other. The maximum interdiurnal increase in sea-level pressure over the middle and western part of Europe takes place, on the average, 2 to 4 days after very intense ultraviolet invasions. One day after the invasion the maximum pressure rise has a particularly low value; this, in similar

measure, is repeated only 7 days after the invasion. The amplitude of the sea-level pressure reaction is also here greater in winter (5.3 mb.) than in summer (2.8 mb.).

With the aid of the data of the absolute topography of the 500-mb. surface, which are likewise published in the *Taeglicher Wetterbericht* of the Deutsche Seewarte for an area between 45° and 60° N. latitude and 5° W. longitude and 25° E. longitude, an attempt has been made to answer the question, "Does the pressure at a height of approximately 5,000 m. react to strong ultraviolet invasions, and

The Average Behaviour of Maximum Interdiurnal Increases in Sea-Level Pressure over the Area 45° NL to 60° NL and 10° WL to 20° EL, as related to all (51) very Intense Ultraviolet Radiation - Invasions (BETWEEN 0900 AND 1500 GMT) which were not preceded on the previous 5 Days by equally strong Invasions.

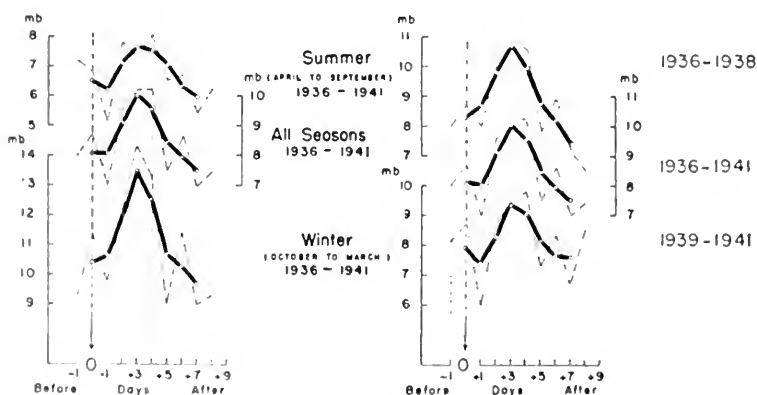


FIG. 18.

if so, how?" This special investigation has been made by the same method and with the same key days of the years 1936 to 1941 as the other statistics, demonstrated in the figures 17 and 18. In figure 19 some of the results of this investigation are shown. The three maps on the left-hand side of the figure represent the average change of the absolute topography of the 500-mb. surface in dkm. which has taken place on all the days with very intense ultraviolet invasions since the immediately preceding day, above for the summer months April to September, in the middle for all seasons, and below for the winter months October to March. The distribution of the isallohypses, or lines of equal change of height, on these maps is rather irregular;

The Average Behaviour of the Absolute Topography of the 500 mb - Surface as related to all (51) very Intense Ultraviolet Radiation - Invasions (between 0900 and 1500 GMT) which were not preceded on the previous 5 Days by equally strong Invasions.

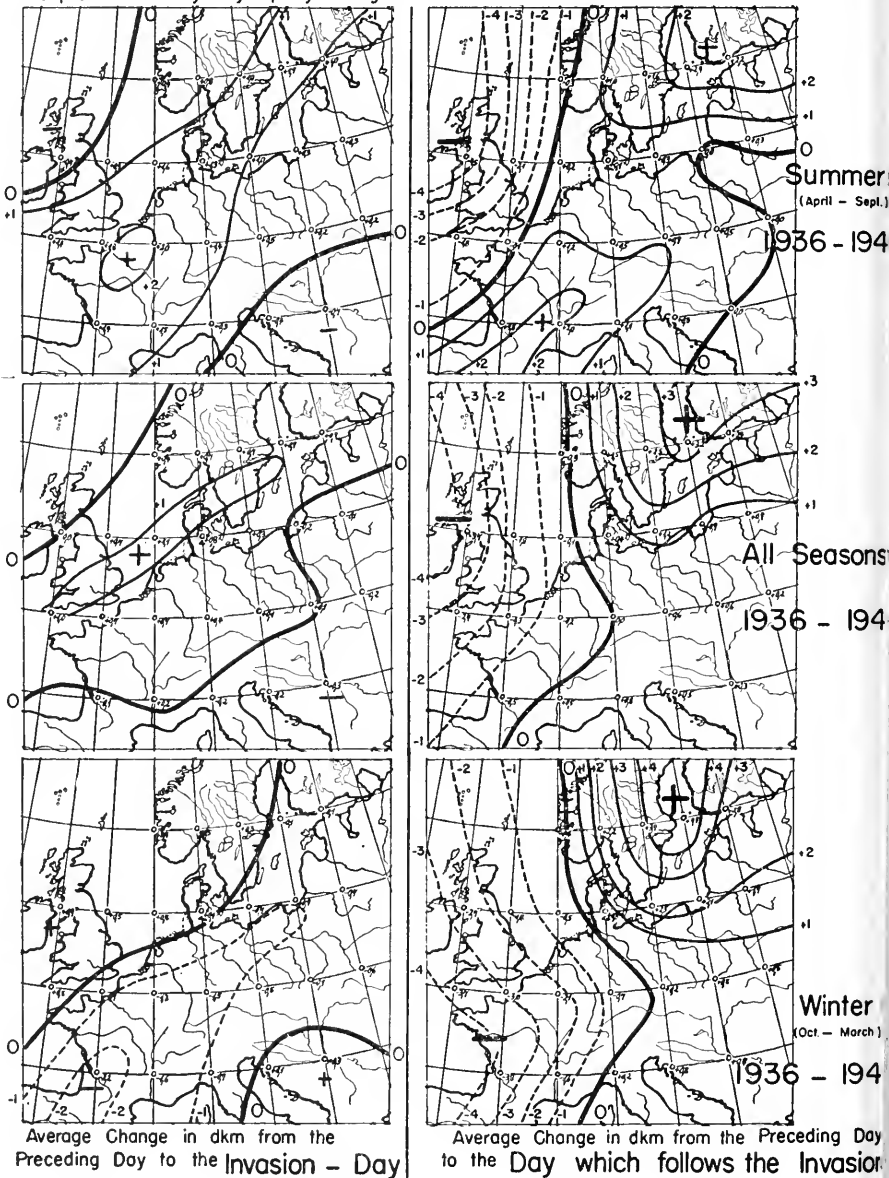


FIG. 19.

the zero line is most dominating. The greatest differences between the maximum lifting and the maximum sinking are accordingly relatively small and amount to 2.7 dkm. in summer, 3.1 dkm. in winter, and to only 1.3 dkm. for all seasons together. One day after the ultraviolet invasions the picture has changed fundamentally, as can be seen from the right-hand side of figure 19. Here is shown the average change of the absolute topography of the 500-mb. surface in dkm. which has taken place 1 day after all very intense ultraviolet invasions since the day which preceded these invasions. The distribution of the isallohypses is by no means more irregular. There has developed a strongly marked area of sinking over western Europe and a rather distinct area of lifting over northern Europe. The location of the lifting area is the same in the winter and summer, whereas the sinking area is situated somewhat more southward in winter and somewhat more northward in summer, compared with the average over all seasons. The differences between maximum lifting and maximum sinking are relatively great, and amount to 6.9 dkm. in summer, 8.2 dkm. in winter, and 6.9 dkm. for all seasons. That means that there occurs in the course of 24 hours, and in the average of 6 years, an increase of the differences by 4.2 dkm. in summer, 5.1 dkm. in winter, and 5.6 dkm. in the average for all seasons. However, more comparative study is necessary before any definite conclusions can be drawn from these results.

Reliable data about bright chromospheric eruptions are available for only a few years. However, for future work, to be done on a very broad basis, it might be desirable to extend such investigations to years which lie farther in the past. For that reason we investigated the possibility of using, instead of bright chromospheric eruptions, other observational data from the sun, e.g., data which could likewise, even if in a more or less simplified manner, represent such increased sun activity as is connected with ultraviolet eruptions. On the basis of investigations which have been made by W. M. Goodall (29) in this connection, and by T. Duell and B. Duell (30), the calcium flocculi of the whole sun disk were finally taken on approval as a substitute for direct observations of eruptions. In these statistics we proceeded not from the controlling element, i.e., sun activity, but from the hypothetically subordinated meteorological element. The reason for this was, that in the case of the calcium flocculi it is occasionally very difficult to select a certain number of distinct and well-defined extreme values, e.g., the five highest figures in every month, because of the occurrence of many character numbers of equal value. As key days all 101 days of the years 1936-1941 were selected on

which interdiurnal decreases in sea-level pressure ≥ 5 mb. had been observed in Frankfurt a.M., and furthermore all 121 days, on which interdiurnal increases in sea-level pressure ≥ 5 mb. had been observed at the same station. For these so selected key days, as well as for 11 preceding and 6 following days, average calcium flocculi character numbers have been computed by means of the superposed-epoch method. Moreover, a subdivision of these statistics has been made according to different seasons and to years with increasing and decreasing sun activity. The results are represented in

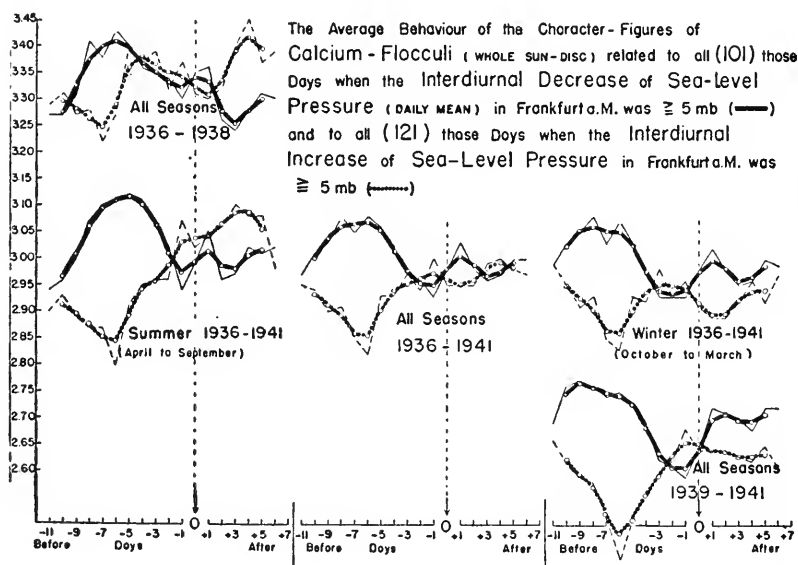


FIG. 20.

figure 20. The similarity between the winter and the summer curves is again striking; the same is on the whole true for the years with increasing and decreasing sun activity, although even here the tabulations are completely independent of each other. Besides, the opposite course of those calcium curves which were computed for the pressure decreases, and of those calcium curves which were computed for the pressure increases, is rather remarkable. As to the sea-level pressure increases, it can be stated that 3 to 5 days before these increases the calcium flocculi character number likewise increases distinctly, after having been particularly low 6 days before the key dates. This finding is compatible with our previous statement that the sea-level pressure in Frankfurt a.M. shows a maximum 4 to 6 days after intense ultraviolet invasions. The assumption made hereby,

namely, that the number of calcium flocculi increases during and shortly after bright chromospheric eruptions, agrees with our present knowledge of solar physics. Analogous to the behavior of the calcium numbers before pressure increases, 3 to 5 days before sea-level pressure decreases the calcium flocculi character numbers likewise decrease, after having been on the average particularly high 6 days before the key dates. On the whole it can be seen from figure 20 that it is not quite hopeless to use certain other solar indices instead of direct observations of ultraviolet eruptions, if reliable observational data about the bright chromospheric eruptions are not available.

One fact results rather clearly from figures 17 to 20, namely, that in contrast to the solar particle invasions, the influence of the solar ultraviolet invasions upon sea-level pressure seems to exist not only in winter and in years with low sun activity, but also in summer and in years with high sun activity.

C. ATTEMPT AT A PHYSICAL EXPLANATION OF THE OBSERVED RELATIONSHIP

In the following chapter an attempt will be made to give a schematic description of the manner in which the influence of short-duration eruptions of extreme short-wave ultraviolet solar radiation is transmitted to the troposphere. As some of the physical possibilities which must be considered in that connection have already been mentioned, when the possible effects of particle invasions were discussed, the discussion can be confined here to a few facts of special interest. Even on this occasion it cannot be stressed too strongly that our description is rather hypothetical and doubtless will undergo modifications if further light is thrown on these problems by other investigators.

The origin of these ultraviolet eruptions is confined almost exclusively to a solar zone which lies between 40° N. latitude and 40° S. latitude. There they appear mostly in the near vicinity of sunspot groups which are found in a certain phase of development: Nr. IV and V of the Brunner classification (31). Attendant solar phenomena are the bright chromospheric eruptions which are observable by means of a spectroheliograph or a spectroheliograph, because of the simultaneous excitement of lines in the visible part of the spectrum, and furthermore certain kinds of prominences. Known geophysical consecutive reactions are: the "Bay-disturbances" of the earth-magnetic elements and of the electric earth current; an abnormal D-layer, the appearance of which is connected with a short-duration "fade-out"

of short radio waves, known as "Moegel-Dellinger effect"; and, finally, an increase in the number and intensity of a certain kind of static in the range of very long radio waves ($\lambda \sim 10,000$ m.), and likewise a considerable reinforcement of the so-called "solar noise" in the range of ultrashort- and decimeter-waves. The influence of these ultraviolet invasions is possible only on the sunlit earth hemisphere.

During the absorption of ultraviolet photons in the high atmospheric layers, their energy produces ionization, dissociation, especially of the molecular oxygen, heating and formation of certain chemical compounds, partly in the form of condensation nuclei. Furthermore there can be expected, according to L. Vegard (32), an electric polarization of the ionosphere during the ultraviolet irradiation because of the photoelectric expulsion of high-energy negatrons which move upward and reach considerable heights. Possible effects of such a strong ionospheric-electric field on unstable tropospheric situations have been discussed already in part I of this paper.

The heating of the absorbing gases and the dissociation of the molecular oxygen lead to a momentary pressure rise in the absorbing layer. Details about the amount of that pressure rise are not yet known.

The formation of certain chemical compounds, especially of O_3 , H_2O_2 , NH_3 , N_2O_5 , NH_4NO_2 , and NH_4NO_3 , by ultraviolet irradiation of the high atmosphere, has been emphasized for many years by P. Lenard and C. Ramsauer (33). The importance of such chemical compounds for the condensation of water vapor has been discussed before Lenard by E. Pringal (34), E. Barkow (35), F. Richarz (36), and later also by W. Bieber (37). The relationship between high sun activity and the radius of the circumsolar shine, which has been treated in detail by J. Maurer (38) and C. Dorno (39), points likewise to atmospheric-turbidity phenomena which are produced by an intensified ultraviolet irradiation. It may be assumed also that the statistical accumulation of sun halos 2 days after intense chromospheric eruptions, which has been stated by G. Archenhold (22), is due to the additional production of condensation nuclei during ultraviolet invasions. The possibility of a down-sucking of the solar-produced condensation nuclei over cyclones in state of development (Palmén, Refsdal) and certain thermodynamic consequences have already been discussed on the occasion of examining the effects of solar particles. The same is true for the regionally intensified

infrared emission of the stratosphere which would follow a local turbidity, produced by nuclei.

A very essential difference between the dissociating and nuclei-producing effect of solar particle invasions on the one side, and the allegedly same effect of solar ultraviolet invasions on the other side, might be that the solar ultraviolet photons penetrate much deeper into the earth atmosphere than the solar particles. This fact is of great importance in the question of solar effects on the stratospheric ozone layer. As early as 1943 F. Moeller (40) pointed out that a reasonable explanation for the relationship between changes of solar ultraviolet radiation and variations of sea-level pressure would be possible by making the following assumptions: The effective infrared emission of the atmospheric carbon dioxide in the spectral range between 13 and 16μ , which is of importance for the changes in the temperature of the stratosphere and consequently also for changes of sea-level pressure, is highly dependent on the amount of stratospheric ozone which likewise has a strong absorption band between 13 and 16μ , and therefore screens off more or less the emission of the lower CO_2 . The assumption that the amount of stratospheric ozone is influenced by variations of solar ultraviolet radiation is not unreasonable, and is strongly supported by theoretical considerations of B. Haurwitz (41), published in 1946. Haurwitz, too, stresses the important role which must be ascribed to the stratospheric ozone in the case of a relationship between solar ultraviolet radiation and sea-level pressure. After respective computations he comes to the conclusion that the likelihood of appreciable pressure variations at the ground produced by solar activity can be asserted and that such pressure variations must be accompanied by substantial motions of the air in the troposphere. Nevertheless he notes that the atmosphere will respond differently to the same solar impulse, depending on its initial state. Also O. R. Wulf (42) emphasizes in recent publications that the heating of the high atmosphere by solar ultraviolet radiation, which is absorbed by the oxygen and ozone, together with the emission processes of the stratospheric ozone, carbon dioxide, and perhaps even of the water vapor and the oxides of nitrogen, represent probably the most important causes for the development of meridional pressure gradients.

A brief summary of the different hypotheses which could possibly explain the effect of solar ultraviolet invasions on the stratospheric and tropospheric circulation and large-scale weather situation, is presented in figure 21.

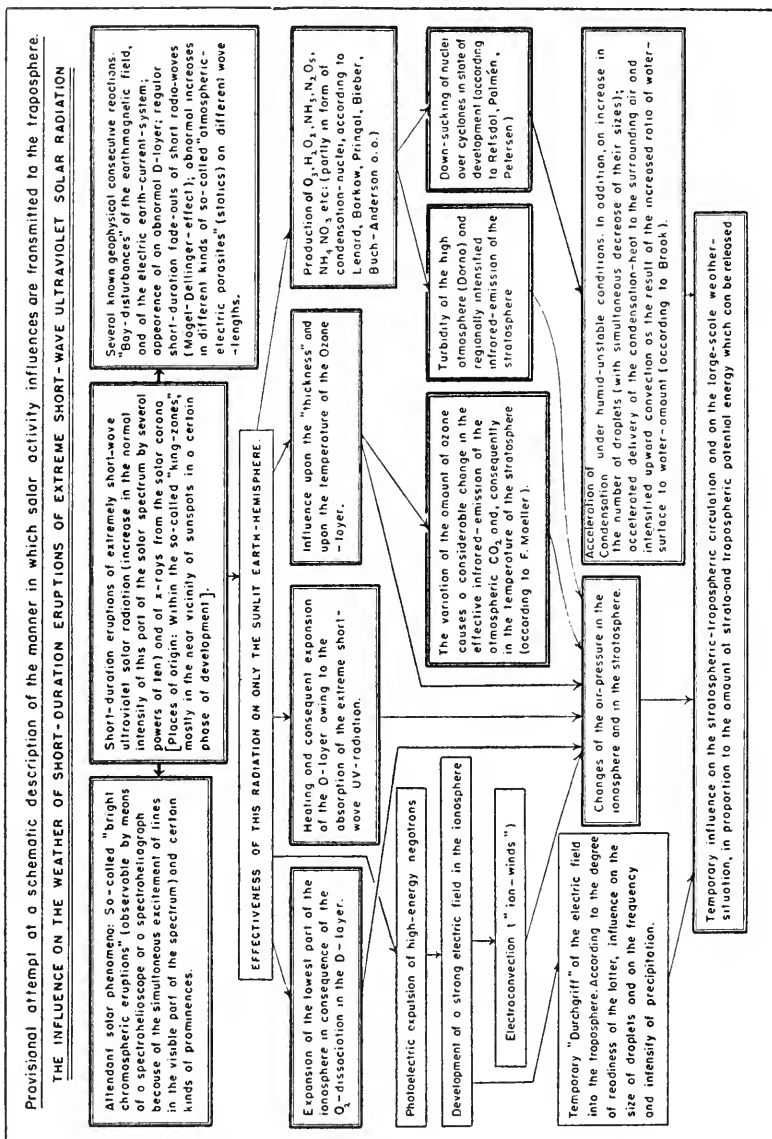


FIG. 21.

CONCLUSIONS

In conclusion, it must be emphasized that the results described in this paper are by no means so unequivocal that their immediate application to short- or middle-term weather forecasting would be possible. Before rules for the forecaster can be worked out, there is need of further investigations, performed on a very broad scale. Essential improvements of that working basis seem to be possible. For instance, to characterize the occurrence and intensity of ionospheric storms, direct data, provided by means of the impulse-echo method, should be used, instead of the geomagnetic character numbers for such statistics. Also the occurrence frequency and intensity of ultraviolet invasions could possibly be better characterized by systematically recorded data concerning the appearance of an abnormal D-layer on the sunlit earth hemisphere, than by direct observations of the bright chromospheric eruptions. The reason for this is that a really reliable international sun-control service, observing the chromosphere without any interruptions, does not yet exist. Furthermore, it will prove of particular importance to subdivide such statistics into several groups, which correspond to the different thermodynamic initial states of the troposphere over the considered area at the time of the solar-ionospheric impulses. Probably only by means of such a refined analysis will the different reactions of the troposphere to certain solar-ionospheric impulses of equal size be clarified to such a degree that the forecaster can derive advantages from this research.

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SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 110, NUMBER 9

A NEW GENUS AND FIVE NEW
SPECIES OF AMERICAN FISHES

BY

SAMUEL F. HILDEBRAND

U. S. Fish and Wildlife Service



(PUBLICATION 3943)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
JULY 28, 1948

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

A NEW GENUS AND FIVE NEW SPECIES OF AMERICAN FISHES

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The new forms herein described were discovered more or less incidentally during the past several years while working with various groups of tropical and subtropical fishes. It seems advisable to publish the descriptions now, as some of the names are desired for inclusion in a general work.

The types of the new species are all in the National Museum, and their catalog numbers are given in the accounts of the species. The writer is indebted to Dr. Alexander Wetmore, Secretary of the Smithsonian Institution, and to Dr. Waldo L. Schmitt, head curator of zoology, and Dr. Leonard P. Schultz, curator of fishes, in the National Museum, for laboratory space and for the use of the specimens needed in the studies that led to the discovery of the new genus and the new species described in these pages.

Family TORPEDINIDAE

NARCINE SCHMITTI, new species

FIGURE 1

Disk somewhat narrower than long, its anterior outline moderately broadly rounded, with tip of snout projecting very slightly, its width 2.3 in total length; its length 2.0; length anterior to axil of pectoral 2.1; length anterior to vent 1.95; length posterior to vent 2.1; tail robust, not strongly depressed, its width at axil of ventrals 5.15 in length anterior to vent; its depth at same place 5.7; depth of its peduncle 4.65 in snout; tail with a rather feeble lateral dermal fold, beginning behind first dorsal; snout rather short, its length anterior to eye 3.85 in length anterior to vent, its preoral length 3.6; eye and spiracle about equal in size, the former 5.0 in snout anterior to eye; space between spiracles 1.8; mouth small, its width 1.85 in snout; teeth rounded, each tooth with a rather prominent, pointed posterior cusp; the two dorsal fins of about the same size and shape, the base of the second one 1.75 in snout, and its height 1.15; space between

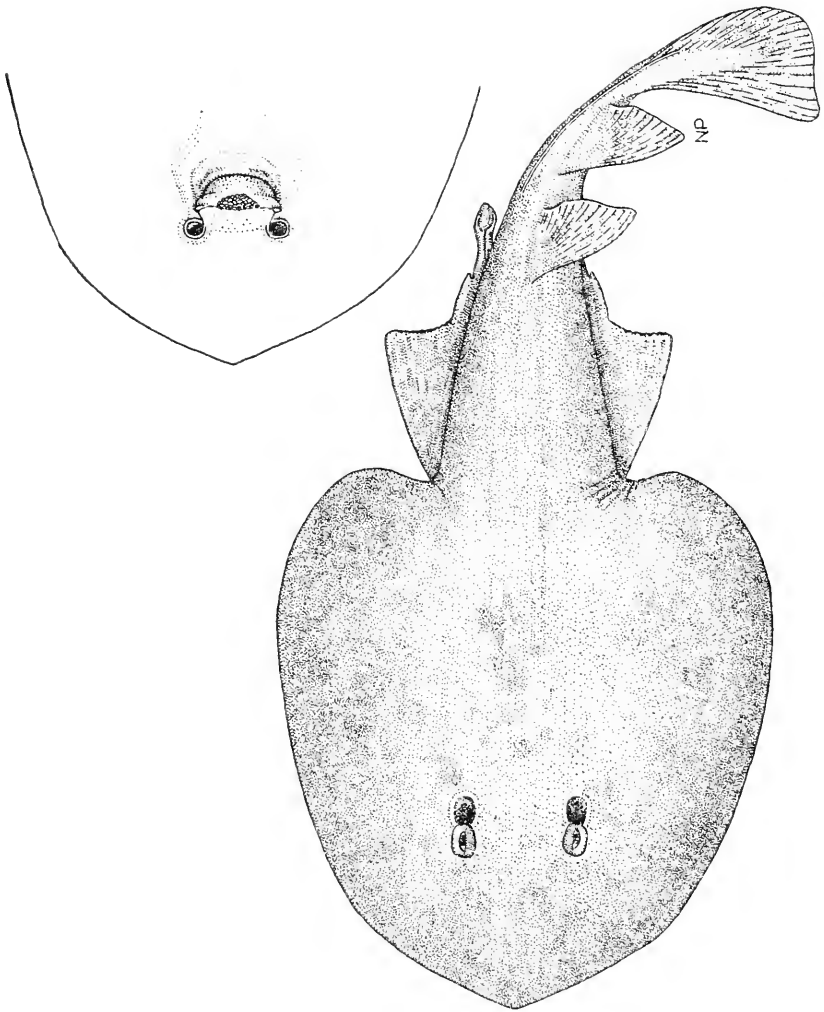


FIG. 1.—*Narcine schmitti*, new species. From the type (U.S.N.M. No. 94044), total length 210 mm., from White Friars Island, off mouth of Gulf of California. Insert, showing mouth and nostrils. Drawing by Mrs. Nancy D. Patton

dorsal fins 3.7; upper part of caudal fin with a rather acute angle, lower part rounded, the rest of margin nearly straight; ventral with nearly straight distal margin, its outer margin 3.7 in length anterior to vent; clasper fully a third longer than adjacent part of ventral, 3.2 in length anterior to vent.

Color brownish above, with many indistinct dark spots; plain pale underneath.

The description offered herewith is based on the holotype, the only specimen known, a male 212 mm. long, taken by Waldo L. Schmitt, for whom this species is named, at White Friars Island, off the mouth of the Gulf of California, dredged in 5 to 10 fathoms, on March 3, 1934 (U.S.N.M. No. 94044).

This species is related to *N. entemedor* Jordan and Starks and *N. vermiculatus* Breder. From the first it differs prominently in the much more robust tail, which is deeper and less strongly depressed, and from the second (of which I have seen no specimens) it seems to differ, according to the published accounts, in having smaller spiracles, which are about equal in size to the eyes, and not notably larger as in *vermiculatus*. It differs from both species in color, as the upper surface is marked with indistinct dark spots, whereas adults of *entemedor* are of a uniform gray, and *vermiculatus* has pale markings.

This species, like *vermiculatus*, seems to become sexually mature at a smaller size than *entemedor*, as the claspers in the 212-mm. male are much longer than the adjacent parts of the ventrals, and apparently fully mature. In a male *entemedor* 215 mm. long they are equal in length to the adjacent parts of the ventrals, and are thin, flexible, and apparently immature.

Family CLUPEIDAE

ILISHA APAPAE, new species

FIGURE 2

Head 4.0; depth 3.25; D. 15; A. 48; P. 14; scales mostly missing, about 60; ventral scutes 26.

Body rather elongate, strongly compressed, its greatest thickness scarcely a third of its depth; dorsal outline in advance of dorsal fin nearly straight; ventral outline strongly convex; chest and abdomen compressed, armed with 20 moderately strong keels in advance of ventral fins and 6 behind them; head fairly large; margin of opercle moderately concave in advance of pectoral, its posterior margin convex; snout shorter than eye, without a definite median notch, 4.45 in

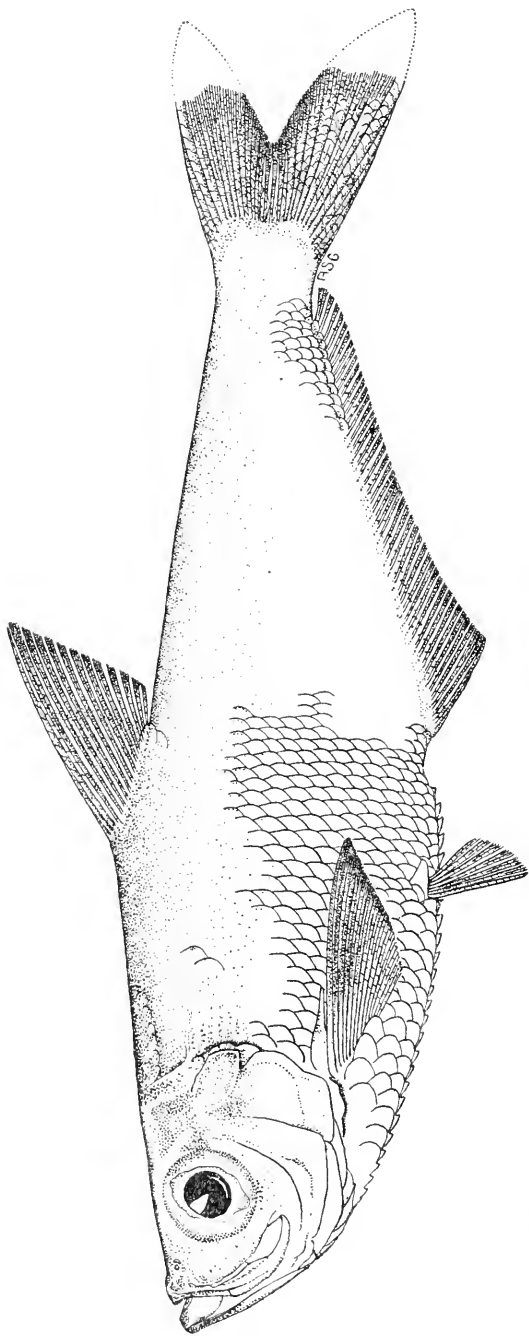


FIG. 2.—*Ilisha ahafoa*, new species. From the type (U.S.N.M. No. 52550), total length 200 mm., taken in Amazon River somewhere between Pará and Manaus, Brazil. (Scales partly lost, indicated only where present.) Drawing by Mrs. Ann S. Green.

head; eye large 2.9; interorbital narrow 10; mouth rather oblique; mandible projecting strongly, almost entering dorsal profile, 1.75 in head; maxillary narrowly rounded posteriorly, reaching below anterior margin of pupil, 1.85 in head; a soft ligament present between premaxillary and maxillary; teeth all small to minute, several in a single series on anterior part of mandible, a series on premaxillary and on margin of maxillary, bands of granular teeth on palatines, pterygoids, and tongue; gill rakers at angle of first arch scarcely half length of eye, 19 on lower limb of first arch; scales from middle of side below base of dorsal fin scarcely deeper than long, not very closely imbricated, with 4 or 5 vertical striae, only the posterior one complete, the margins nearly smooth; dorsal fin high anteriorly, the longest rays reaching far beyond the tip of the last one if deflexed, only a little shorter than head, origin of fin nearer margin of snout than base of caudal by a distance equal to length of snout and eye; caudal damaged, forked, the lower lobe evidently the larger; anal fin long, scarcely elevated anteriorly, its margin nearly straight, origin of fin under last ray of dorsal and equidistant from posterior margin of eye and base of caudal, base of fin 2.4 in standard length; ventral fins long (for an *Ilisha*), inserted rather less than an eye's diameter in advance of vertical from origin of dorsal, and notably nearer origin of anal than base of pectoral, 2.3 in head; pectoral fin large, reaching well beyond base of ventral, 4.3 in standard length, with a free axillary process only about a third the length of fin.

Color of the type, an old preserved specimen, grayish above, yellowish to silvery on sides; upper surface of snout and tip of mandible dark brown; a brownish area behind eye; fins all with dusky punctulations, few and scattered on ventral fins, most numerous on dorsal and caudal and on upper rays of pectoral.

This species is represented in the collection of the National Museum by a single specimen, the holotype (No. 52550), the only one known. It has a total length of about 200 mm. (length to base of caudal 160 mm.), and was taken in the Amazon River somewhere between Pará and Manáos, Brazil.

This species differs from other local forms in having a ligament between the maxillary and premaxillary, where the other tropical Atlantic species of the genus have a bone bearing fine teeth along its margin. The body in *apapae* is elongate, as in *altamazonica*, another local species, but it apparently has larger scales, which are mostly lost, fewer dorsal and more numerous anal rays. Furthermore, *apapae* has more gill rakers than *altamazonica*, but fewer than the other American species of this genus. It is nearest *furthii* from the Pacific

coast of tropical America, which also has a ligament between the maxillary and premaxillary, but *furthii* has more ventral scutes (34 to 37), and the ventral fins are inserted farther forward, being equidistant from the base of the pectoral and origin of the anal in *furthii*, whereas they are inserted notably nearer the origin of the anal than the base of the pectoral in *apapa*.

The name, *apapa*, is from *apapa*, used in Brazilian publications as a name for fresh-water herrings.

NEOPISTHOPTERUS, new genus

Genotype.—*Odontognathus tropicus* Hildebrand, U. S. Nat. Mus. Bull. 189, p. 94, fig. 19, 1946, Puerto Pizarro, Perú, and Balboa, Canal Zone.

This genus belongs to that group of small herrings with a strongly compressed body, a long anal fin which begins in advance of the dorsal fin, and in which the ventral fins are missing. Consequently, the relationship of this genus is with *Opisthopterus* and *Odontognathus*. From these genera it differs importantly in the structure and relative position of the maxillary and premaxillary. In the two old genera mentioned these two elements are separated by a short toothless membranous section (hitherto undescribed). The margin of the upper jaw, nevertheless, is continuous (uninterrupted). In the new genus the margin is discontinuous (interrupted), as the maxillary definitely overlaps the premaxillary, that is, it extends over the distal end of the premaxillary (fig. 4). *Opisthopterus* and this new genus agree in having a relatively short maxillary, which does not seem to be produced into a long narrow process as in *Odontognathus* (at least there is no indication in the rather small specimens, up to 66 mm. in standard length, of *Neopisthopterus* at hand, that this element will become produced with age and growth). Furthermore, in *Opisthopterus* and the new genus the margins of the ventral scutes are entire (smooth), whereas the margins of the posterior ones in *Odontognathus* are sharply serrate. The teeth in *Neopisthopterus* are all small to minute, and are present on the jaws, palatines, pterygoids, and tongue, but missing on the vomer. Vertebrae about 46 or 47.

The anal fin in the two known species of this genus is shorter than in the related genera, being composed of 39 to 48 rays, whereas the species of the genus *Opisthopterus* have about 56 to 65 rays, and those of *Odontognathus* about 58 to 78.

The close relationship between this new genus and *Opisthopterus* suggested the name, *Neopisthopterus*, that is, a new *Opisthopterus*.

This genus to date is represented by two species, *N. tropicus*, the type species of this genus, known from Panamá and northern Perú, and by the new species herein described from Cuba.

NEOPISTHOPTERUS CUBANUS, new species

FIGURES 3 AND 4

Head 4.25 to 4.6 (4.25); depth 4.75 to 5.8 (5.1); D. 13 or 14 (13); A. 39 to 43 (41); P. 13; scales lost, about 43 pockets; ventral scutes 23 to 28 (26); vertebrae 47 (counted in one specimen).

Body moderately elongate, not excessively compressed, its greatest thickness between a third and fourth of its depth; dorsal outline of head straight to slightly convex; ventral outline anteriorly rather strongly convex; chest and abdomen compressed, armed with 23 to 28 (26) scutes; head short, not much longer than deep, its depth at vertical from slight cross groove at occiput 5.2 to 5.8 (5.8) in standard length; margin of opercle rounded, without an indentation in front of pectoral; snout about as long as eye, 3.3 to 4.2 (4.2) in head; eye 3.4 to 4.1 (3.4); interorbital 7.3 to 9.0 (7.4); mouth moderately oblique; mandible projecting slightly, 1.6 to 1.8 (1.75) in head; maxillary rather narrowly rounded posteriorly, reaching to or somewhat beyond vertical from posterior margin of pupil, 1.55 to 1.8 (1.6) in head; teeth all small to minute, apparently in a narrow band on anterior part of lower jaw, those on premaxillary and maxillary in a single series, the row interrupted at point of overlapping of maxillary and premaxillary, very small teeth on palatines, pterygoids, and median line of tongue; gill rakers slender, about as long as pupil at angle, 17 to 19 (18) on lower limb of first arch; scales nearly all missing, rather large, very thin, with smooth margins, and without evident striations; dorsal fin small, somewhat elevated anteriorly, its margin convex, origin of fin rather more than an eye's diameter behind origin of anal and about equidistant from margin of opercle and base of caudal; caudal fin forked, the lower lobe slightly the longer, scarcely as long as head; anal fin moderately long, its origin about equidistant from posterior margin of eye and base of caudal, its base 2.55 to 3.0 (2.55) in standard length; pectoral fins injured, apparently fairly large.

Color of preserved specimens pale; side with a whitish band (no doubt silvery in life), about half as broad as eye; upper surface of head posteriorly brownish with rather large dusky dots; margin of snout medianly and anterior part of mandible with dusky dots; median

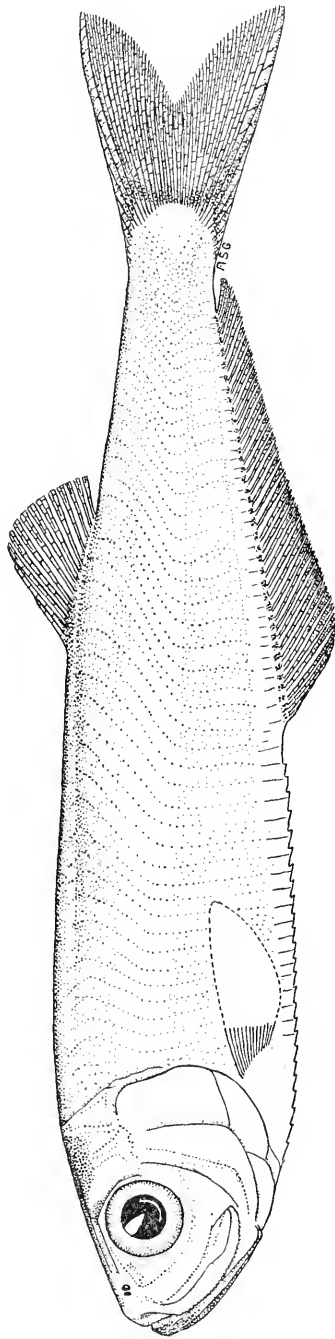


FIG. 3.—*Ncoopisthopterus cubanus*, new species. From the type (U.S.N.M. No. 143569), total length 50 mm., taken at Havana, Cuba. Drawing by Mrs. Ann S. Green.

line of back also with scattered dusky points; these also present on base of caudal, forming a cross line and extending on caudal lobes; base of anal with a row of dark dots, the fin also with dusky dots chiefly near margin.

This species is represented in the collection of the National Museum by the type (No. 143569), a specimen 50 mm. long (41 mm. to base of caudal), and five paratypes 43 to 47 mm. long (35 to 38 mm. to base of caudal), all collected in the vicinity of Havana, Cuba, by Luis Howell Rivero, who sent them to the writer with a collection of

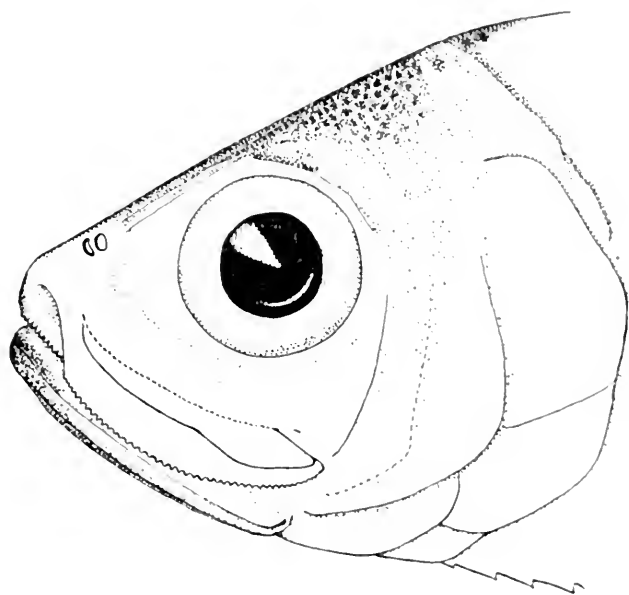


FIG. 4.—*Neopisthopterus cubanus*, new species. From the type (U.S.N.M. No. 143569). Note overlapping of maxillary and premaxillary. Drawing by Mrs. Ann S. Green.

anchovies (Engraulidae). These small fish apparently are not fully mature. The proportions and enumerations enclosed in parentheses in each instance apply to the type.

This species is very close to *Odontognathus tropicus* Hildebrand (U. S. Nat. Mus. Bull. 180, p. 94, fig. 19, 1940), which was described from specimens collected in the Gulf of Guayaquil, Puerto Pizarro, Perú, and at Balboa, Canal Zone. It was learned from a comparison of the type material of *O. tropicus* with the specimens herein described as *N. cubanus* that the two species are congeneric. Because *tropicus* is represented by larger and more mature specimens than *cubanus*,

the former was selected as the genotype. A comparison of the type material of the two species, in fact, has revealed only minor differences, which are shown in the following parallel comparison:

<i>N. cubanus</i>	<i>N. tropicus</i>
Anal fin rather short, with 39 to 43 rays, its base 2.55 to 3.0 in standard length, origin of fin usually equidistant from anterior margin of eye and base of caudal.	Anal fin somewhat longer, with 43 to 48 rays, its base 2.25 to 2.8 in standard length, origin of fin usually equidistant from posterior margin of eye and base of caudal.
Dorsal fin rather short, with 13 or 14 rays, its origin slightly more than an eye's diameter behind origin of anal, and about equidistant from margin of opercle and base of caudal.	Dorsal fin slightly longer, with 14 to 16 rays, its origin scarcely an eye's diameter behind origin of anal, and about equidistant from posterior margin of eye and base of caudal.
Gill rakers 17 to 19 on lower limb of first arch.	Gill rakers 18 to 21 on lower limb of first arch.

This, then, is another instance of the rather common occurrence of "twin" species in the tropical Atlantic and Pacific. Such closely related species generally have been found on the opposite coasts of Panamá. However, as the West Indian (Cuban in this instance) and the Atlantic Panamanian faunas are largely identical, *cubanus* may be expected on the Atlantic coast of Panamá and the neighboring countries.

Family SYNODONTIDAE

SYNODUS CINEREUS, new species

FIGURE 5

Trachinoccephalus myops BEAN (not of Schneider), Fishes in "The Bahama Islands," Geogr. Soc. of Baltimore, 1905, p. 297, Bahama Islands.

Head 4.0, 3.9; depth about 6.1, 7.2 (not accurate because of distortion); D. 12, 11; A. 9, 9¹; P. 12, 13; scales 57, 60, before dorsal 20, 21.

Body about as broad as deep at insertion of ventral fins, caudal peduncle deeper than broad, 4.1, 4.5 in head; head nearly as broad as deep, its upper surface posterior to interorbital with bony ridges; upper anterior rim of eye with coarse serrae; snout broader than long, 5.0, 5.6 in head; eye 4.3, 5.6; interorbital concave, 15, 9.7 in head; mouth large, premaxillary extending far beyond eye, 1.75, 1.7 in head; mandible rounded, without fleshy knob, included in upper jaw; lateral

¹ The last double ray of the dorsal and of the anal was counted as one.

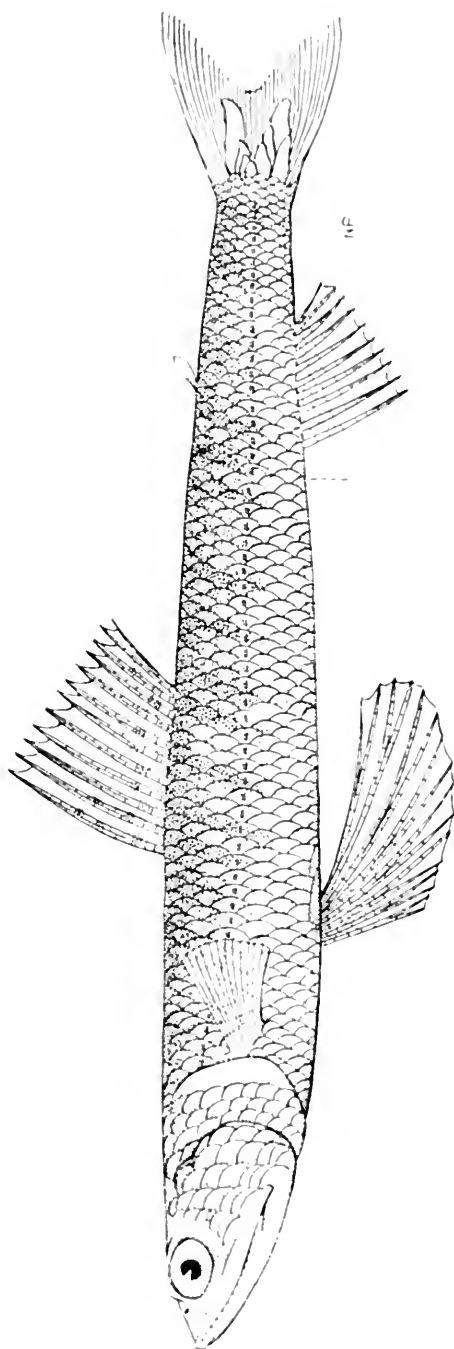


FIG. 5.—*Synodus cinereus*, new species. From the type (U.S.N.M. No. 53070), total length 128 mm., from the Bahamas. Drawing by Mrs. Nancy D. Patton.

line slightly decurved, not forming a keel on caudal peduncle; scales firm, 3 complete rows between lateral line and base of dorsal, those on lower part of cheek and opercle very elongate, in about 8 longitudinal rows; dorsal fin with a nearly straight margin, the anterior rays not reaching beyond tips of the posterior ones if deflexed, longest ray 1.65, 1.75 in head, origin of fin somewhat nearer adipose than tip of snout, its distance from tip of snout 2.35, 2.3 in length; adipose very small, over middle of anal; caudal short (somewhat frayed); anal small, its origin a little more than half as far from base of caudal as base of ventral, its base 8.7, 9.6 in length, 2.15, 2.5 in head; ventral inserted well in advance of dorsal, the inner ray more than twice as long as the outer one, the longest ray about as long as head, 4.3, 4.3 in length; pectoral inserted well below lateral line, scarcely reaching more than halfway to vertical from origin of dorsal, 2.4, 2.4 in head.

Color ash gray above, pale silvery below; back with about 16 brownish cross bars, some of them more or less double, more distinct in the smaller than in the larger specimen; top and side of head with irregular brownish markings; no shoulder spot; dorsal with indications of pearly gray spots, other fins plain.

This apparently new species is represented in the National Museum by two specimens, 72 and 128 mm. in total length, 61 and 108 mm. to base of caudal. These specimens are from the Bahama Islands, and are the ones listed as *Trachinocephalus myops* by Bean (see reference above). The larger one (No. 53079), which has been designated as the type, was taken in Clarence Harbor, and the smaller one at a little island near Nassau. The proportions and enumerations given last in each instance apply to the type.

This apparently new form differs from *S. intermedius* (Agassiz) and *S. poeyi* Jordan, two other local species, in having 57 to 60 scales in a lateral series and 20 or 21 in advance of dorsal, instead of 43 to 52, and 14 to 16 as in the other species. It also differs in the shorter pectoral fin, which reaches only a little more than half way to vertical from origin of dorsal instead of reaching nearly or quite to that point as in *intermedius* and *poeyi*. It differs further from *intermedius* in having only 9 instead of 11 or 12 anal rays, and its base is less than half the length of the head instead of notably longer than half the head. From *poeyi* it differs further in the shorter mandible, which does not end in a fleshy knob, and is included in the upper jaw, instead of ending in a fleshy knob and projecting prominently beyond the upper jaw. It differs from *S. synodus* (Linnaeus) in having only 3 complete rows of scales between the lateral line and the base of the

dorsal, instead of 4 complete rows, and it has 20 or 21 scales on the back in advance of the dorsal where *synodus* has only 15 or 16.

S. cinereus differs prominently from *S. saurus* (Linnaeus) in having only 9 rays in the anal instead of 11 or 12, as well as in the absence of a tentacle behind anterior nostril, which is prominent in *saurus*. It is readily distinguishable from *S. nicholsi* Breder, also from the Bahamas, by the much smaller head, which is contained only 2.9 times in the standard length of *nicholsi*, and by the included lower jaw, which projects in *nicholsi*.

The name *cinereus* was suggested by the ash-gray color of the upper parts of the specimens.

Family SERRANIDAE

DIPLECTRUM MEXICANUM, new species

FIGURE 6

Head 2.9; depth 3.2; D. X, 12; A. III, 7; P. 17; scales 6-53.

Body rather deep (for a *Diplectrum*), fairly compressed, its greatest thickness only a little greater than half its depth; dorsal profile anterior to occiput only slightly convex; caudal peduncle rather strongly compressed, 2.55 in head; snout pointed, 4.6; eye large, 3.6; inter-orbital 8.9; preorbital very narrow, narrower than pupil; mouth large, oblique; lower jaw projecting moderately, its tip well below general dorsal outline of head; maxillary extending below posterior margin of pupil, 2.2 in head; teeth in each jaw in a narrow band, some of the outer ones in each jaw enlarged, villiform teeth on vomer and palatines; angle of preopercle somewhat produced, with 10 or 11 somewhat enlarged spines, the middle ones not especially large, nor notably more divergent, the vertical limb rather strongly serrate, the horizontal limb mostly smooth; gill rakers rather robust, those at angle about half length of eye, 12 on lower (including rudiments), and 8 on upper limb, of first arch; scales firm, strongly ctenoid, in 6 oblique rows on cheek, larger on opercle, 4 in an oblique series below base of opercular spine; dorsal spines slender, rather high, fourth and fifth spines of about equal length, not quite twice the length of the ninth spine, and a little longer than the highest soft rays, 2.0 in head; caudal forked, the upper lobe longer than the lower; anal spines small, graduated, the second scarcely stronger than the third, 5.3 in head; ventral inserted slightly in advance of base of pectoral, with a slender spine contained 2.4 in head; pectoral reaching well beyond tip of ventral, about to vertical from vent, with a rather symmetrically rounded margin, 1.3 in head, 3.75 in length.

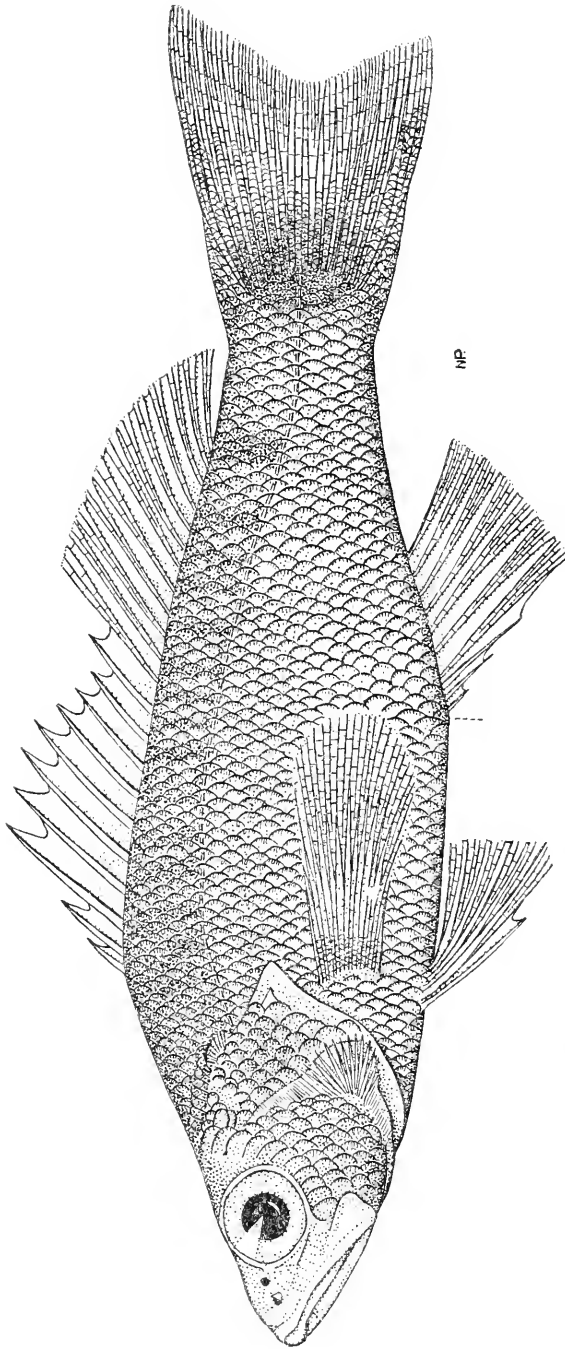


FIG. 6.—*Diplectrum mexicanum*, new species. From the type (U.S.N.M. No. 46518), total length 122 mm., from Gulf of California. Drawing by Mrs. Nancy D. Patton.

Color brown above lateral line, pale brownish to pale silvery below; back posteriorly with slight indications of narrow cross stripes; a dark blotch on opercle, and another one at base of caudal; fins plain translucent, the anal and ventrals a little paler than the other fins.

This apparently new species is represented in the collections of the National Museum by the holotype (No. 46518), 125 mm. (94 mm. to base of caudal) long, the only specimen known, which was taken in the Gulf of California, at $30^{\circ}18' N.$, $113^{\circ}05' W.$, by the *Albatross*, on April 24, 1889.

The deep body, the almost straight gently elevated dorsal profile of the head, the large scales, rather small number of gill rakers, the long slender dorsal spines, and the short anal spines distinguish this species from the others of the genus of the Pacific Coast.

This species was named *mexicanum* because the type was taken in Mexican water.



SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 110, NUMBER 10

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INCLUDING MITES AND TICKS

BY

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Collaborator, Bureau of Entomology and Plant Quarantine
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INTRODUCTION

Inasmuch as feeding is the function of prime importance with all animals, it seems strange that no animals were originally endowed with organs of feeding other than an intake opening into the alimentary tract and a sucking device for the ingestion of nutrient material. Primitive animals, therefore, swallowed water or mud and depended for their subsistence on what organic matter might be therein con-

tained; and many modern animals still feed in this manner. It was left to evolution to produce accessory mouth structures for grasping, tearing, crushing, or chewing that would enable their possessors to get food in more concentrated form from plants or from the bodies of other animals. Since such organs are entirely different in the different groups in which they occur, it is clear that they have been independently developed. Thus we find in the polychaete worms a pair of eversible pharyngeal hooks serving as jaws, in the mollusks a rasping apparatus, in the sea urchins a complex apparatus with a set of movable prongs surrounding the mouth, in the mandibulate arthropods a pair of jaws fashioned from the bases of a pair of legs, and in the vertebrates jaws derived from gill arches.

The arachnids come from an ancestral line that never acquired organs for mastication, and even today they have no true jaws. The ancient trilobites probably were mud eaters; though they had plenty of legs, the legs were not structurally differentiated for special purposes, as in modern arthropods. The leg bases, it is true, were provided with strong, spiny mesal processes, but the latter did not meet along the midline of the body, and could have had little use as feeding organs other than perhaps that of stirring up the mud from which the animals obtained their food. Likewise, true jaws have not been developed in the Xiphosurida, though the first appendages of these animals have taken the form of a pair of pincers, the chelicerae, which serve for grasping and are said to be used for putting food into the mouth, and the coxae of the next five pairs of appendages are provided with large, spinous lobes, more highly developed than those of the trilobites, but still not adapted for efficient mastication of food. The mandibulate arthropods, however, have finally produced from the coxae of the second postoral appendages a pair of strong biting and chewing jaws.

Chelicerae are characteristic appendages of the Xiphosurida and the Arachnida. It is probable, therefore, but not a necessary assumption, that the arachnids and the xiphosurids inherited their chelicerae from some common progenitor. However, in the possession of chelicerae and legs, the primitive arachnids were well equipped for predatism and for terrestrial life; but, being without masticatory organs, they were forced to subsist on the liquids they could obtain from their prey. A liquid diet requires an ingestion pump, and, with all arachnids, a highly developed sucking apparatus constitutes the essential part of the feeding mechanism. Further structural evolution related to the feeding function of the Arachnida, therefore, should logically be in the direction of furnishing an efficient means

of conveying liquids to the mouth from the prey held and crushed in the chelicerae. A comparative study of the external arachnid feeding organs shows, in fact, that the mouth parts are elaborations of structures associated with the oral aperture to form a preoral food receptacle and conduit to the sucking pump. That such accessory feeding organs are not primitive becomes evident when we find that in each arachnid order a different kind of structure has been evolved. The several orders of the Arachnida, therefore, with respect to the feeding apparatus, have no serial relation to one another.

The entomologist who takes up a study of Arachnida obviously must readjust much of his anatomical outlook. Because insects and spiders are closely associated in nature, the study of arachnids has been a sort of sideline for entomologists; for which reason, probably, we find in the language of arachnology various terms that have been carried over from entomology, and, as might be expected, often applied to parts that have no homology with organs of insects. Particularly is this true with respect to the feeding organs. It is a part of the object of the present paper to eliminate entomological terms that have no proper application to arachnid anatomy. The vertebrate zoologist, of course, might justly contend that entomologists have no right to the many vertebrate terms that are given to insect structures. However, conceding that names may be legitimately borrowed, they should be applied consistently at least within any one phylum; otherwise definitions become conglomerations, and morphology is handicapped by a meaningless terminology.

I. GENERAL DISCUSSION OF ARACHNID STRUCTURE

The fundamental structure of an arachnid is best understood from embryonic development. The young arachnid embryo (fig. 1 A, B), as the embryos of other arthropods, consists of a segmented or partly segmented body and a large head lobe (*III*), which may be deeply cleft into lateral halves. Behind the cephalic lobe are the true somites, beginning with the somite of the chelicerae (*A, I*), which is followed by that of the pedipalps (*II*), and the four leg-bearing somites (*III-VI*). The embryonic head lobe of the arthropods always bears the labrum, the eyes, and the antennae if the latter are present, but the arachnids in common with the xiphosurids lack antennae, though these appendages were well developed in the trilobites. With development of the arachnid embryo, the labrum remains as a preoral, or supraoral, lobe of the head, but the ocular region extends posteriorly on the dorsum (*C, D, III*) and becomes the eye-bearing

region of the back in the adult united with the tergal plates of following segments in the dorsum of the prosoma. The chelicerae become secondarily preoral, and in most cases the pedipalps take positions at the sides of the mouth.

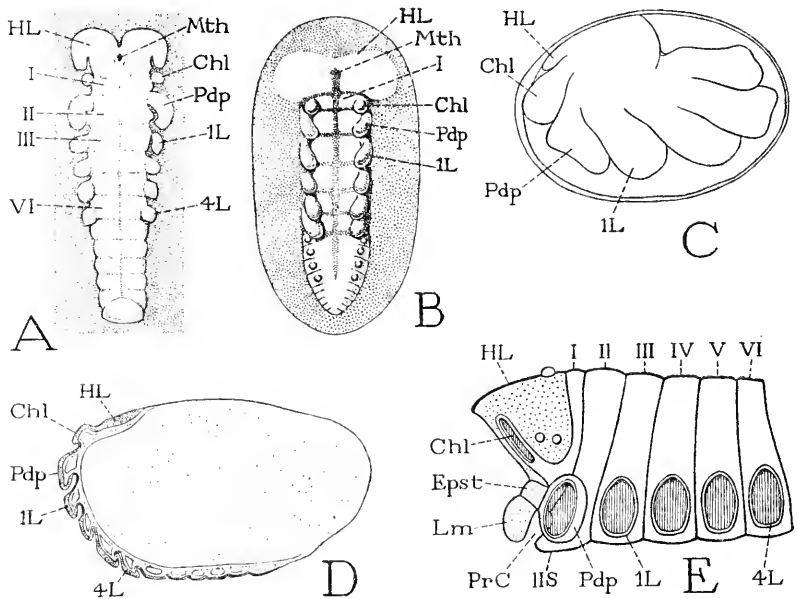


FIG. 1.—The prosomatic segmentation and appendages of Arachnida.

A, young embryo of *Euscorpis italicus* (Hbst.), extended in a plane, showing cephalic lobe (*HL*) and postoral somites with appendage rudiments (from Laurie, 1890). B, embryo of *Agelena labyrinthica* L. (from Balfour, 1880). C, young embryo of *Pediculopsis graminum* (Reuter) in the egg just before reversion, lateral (from Reuter, 1909). D, embryo of *Euscorpis italicus* (Hbst.), longitudinal section through germ band to one side of median plane, showing cephalic lobe (*HL*) extended posteriorly on dorsal surface (from Laurie, 1890). E, diagram of the approximate prosomatic segmentation of an adult arachnid; the primitive cephalic lobe (*HL*, stippled) forms the eye-bearing part of the back, the epistome (*Epst*), and the labrum (*Lm*), and is invaded on the sides by the primarily postoral chelicerae (*Chl*); the pedipalp coxae (*Pdp*) turned forward and united mesally with the epistome.

Chl, chelicera; *Epst*, epistome; *HL*, cephalic lobe of embryo; *I-VI*, postoral somites of prosoma; *IIS*, sternum of pedipalp somite; *1L-4L*, legs; *Lm*, labrum; *Mth*, mouth; *Pdp*, pedipalp; *PrC*, preoral food cavity.

The prosomatic segmentation of an adult arachnid, visualized from the known facts of anatomy and embryogeny, must be approximately as shown diagrammatically at E of figure 1. The part of the prosoma derived from the cephalic lobe of the embryo (*HL*, stippled) certainly includes the labrum (*Lm*), an epistomal region (*Epst*) differentiated at the base of the labrum, and the eye-bearing region of the back; it

therefore includes also the narrow median strip of the anterior body wall connecting the epistome with the carapace between the cheliceral bases. The somite of the chelicerae is postoral in the early embryo (A, B, *I*), but the chelicerae in their preoral transposition invade the anterior part of the primary cephalic region (E, *Chl*), while the sternal part of the cheliceral somite, except possibly in Palpigradi, becomes so reduced that it is not recognizable in the adult structure. The appendages of the second postoral somite, the so-called pedipalps (A, B, *Pdp*), retain the primitive position in the Palpigradi, but in the other arachnid orders they move forward to the sides of the mouth (E, *Pdp*), and generally their dorsal walls unite with the epistome (*Epst*). Either the sternal plate of the pedipalp somite (*IIS*) or some other structure forms a lower lip projecting in front of the mouth, and there is thus enclosed, between the pedipalp coxae on the sides and the labrum (*Lm*) above, a *preoral cavity* (*PrC*) for the reception of food.

The simple basic structure of the anterior part of an arachnid is well shown in a medium sagittal section, such as is represented diagrammatically at D of figure 2. The eye region of the dorsum, the intercheliceral space, the epistome (*Epst*), and the labrum (*Lm*) represent the cephalic lobe of the embryo. From the anterior margin of the back or carapace (*Cp*), the membranous front wall of the body (*a-c*) is reflected downward or obliquely backward, and bears the chelicerae (*Chl*) in their secondarily acquired supraoral position. Below the chelicerae the epistome (*Epst*) extends forward, and supports the labrum (*Lm*). The labrum is a free lobe, but the epistome lies between the pedipalp coxae and is generally united with their dorsal surfaces (A). Beneath the base of the labrum is the mouth (D, *Mth*). Projecting below the mouth is a lower lip, which may be the deutosternum (*IIS*), as shown in the diagram, or some other structure replacing the latter. Between the labrum and the lower lip, however the latter may be formed, is the preoral food cavity (*PrC*) enclosed laterally by the pedipalp coxae. The mouth leads directly into the sucking organ known as the pharynx (D, *Phy*), the dorsal dilator muscles of which (*dld*) are seen in the section to take their origins on the epistome (*Epst*). Modifications of these features occur in each of the arachnid orders, and are carried farthest in the Acarina, but they are clearly all derived from a simple basic structure.

The labrum and the epistome.—A labrum is a part of the standard equipment of all arthropods from trilobites to insects, and there is no apparent reason for calling the preoral lobe of an arachnid anything else than *labrum*. Yet we find the organ described under such

various names as "epipharynx," "camerostome," "rostrum," "lingula," "tonguelike process," and "styletlike process." The arachnid labrum is variable in size and shape in different groups, but it is always present as a lobe of some form projecting above and beyond the mouth at its base (fig. 2 A, *Lm*).

Proximal to the labrum, and supporting the latter, there is in most arachnids a distinct median plate (fig. 2 A, *Epst*) below the chelicerae. This plate has been regarded as a basal part of the labrum, or recognized as an individual structure under a variety of names, such as "clypeus," "epipharynx," "intermaxillary jugum," "subcheliceral plate." Since the plate in question is usually well separated from the labrum, and is postoral in position, it is evidently a part of the head wall; it corresponds with the *epistome* (clypeus) of mandibulate arthropods, and hence may be so named in the arachnids.

The arachnid epistome is not always distinctly separated from the labrum, and it may be more or less invaginated into the anterior body wall beneath the chelicerae, but it is to be identified by one or both of two characteristic relations to other structures. First, the plate is usually united with the pedipalp coxae, forming a bridge between their dorsal surfaces (fig. 2 A, *Epst*); and second, it *always* gives origin, either directly or by means of a basal apodeme, to the dorsal dilator muscles (*D*, *dld*) of the pharynx (*Phy*). In the xiphosurid *Limulus* also an epistomal plate (fig. 2 C, *Epst*) may be distinguished from the labrum (*Lm*); it here supports the chelicerae (*Chl*), and, while it is not united with the pedipalp coxae (*IICx*), it sends out a long arm on each side close to the coxal margin.

The chelicerae.—The chelicerae, being the first postoral appendages of the arachnid, must represent the corresponding appendages of the mandibulate arthropods, and these appendages are the second antennae of Crustacea, or their homologues, the vestigial premandibular appendages transiently present in some insect embryos. The homology of the arachnid chelicerae with the crustacean second antennae is accepted by Störmer (1944) as obvious from the facts of comparative anatomy, and is fully confirmed by the origin of the cheliceral nerves from the tritocerebral lobes of the brain, as shown by Holmgren (1920) and by Hanström (1928). The similar position of the arachnid chelicerae and the crustacean second antennae on the head is at once evident on comparison of a facial view of an arachnid (fig. 2 A) with that of an amphipod (E), and in the phalangid *Leiobunum* (fig. 16 A), as in the amphipod *Talorchestia* (fig. 2 E), a median bar (*f*) connects the epistome with the dorsal wall of the head. The chelicerae of the Chelicerata, therefore, are not the an-

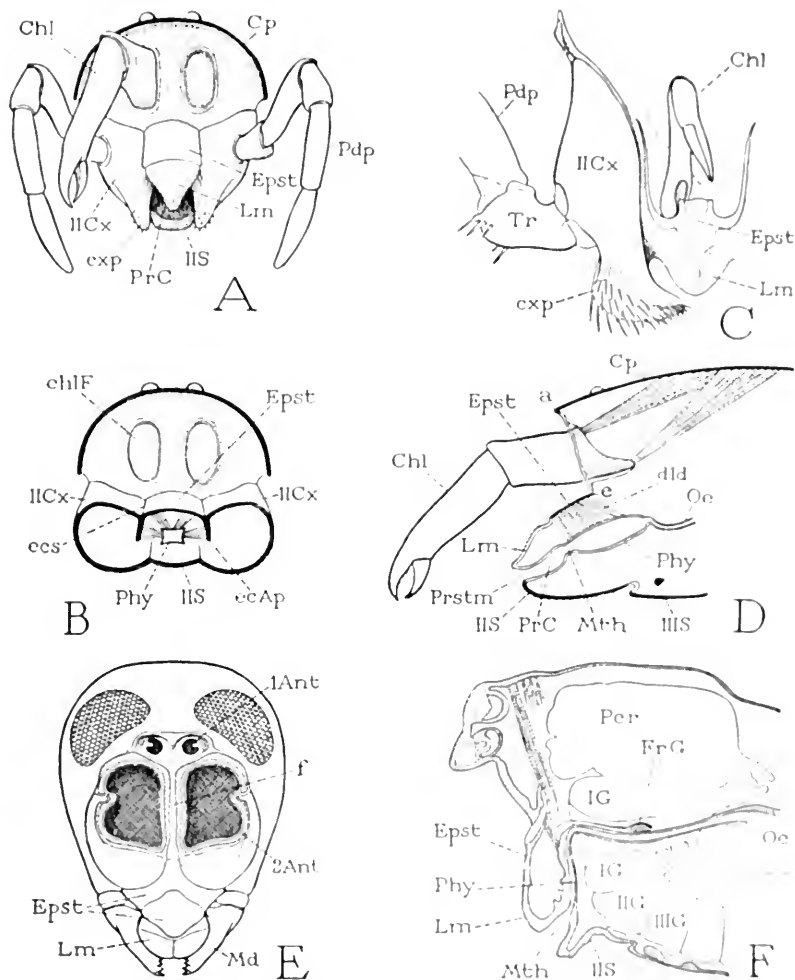


FIG. 2.—Cephalic structures of Arachnida, Niphosurida, and an amphipod crustacean.

A, anterior view of an arachnid, diagrammatic, the under lip represented as the pedipalp sternum (*IIS*) as in *Araneida*. B, the same with chelicerae removed and the mouth parts sectioned transversely behind the palps, exposing the pharynx and its muscles. C, *Limulus polyphemus* L., the mouth region, anterior, with right chelicera and base of right pedipalp. D, diagrammatic longitudinal section of A, showing the preoral cavity (*PrC*), pharynx (*Phy*), and dorsal pharyngeal muscles (*dld*) arising on the epistome (*Epst*). E, *Talorchestia longicornis* Say, amphipod crustacean, anterior view of head showing second antennae (*2Ant*) in position of chelicerae of an arachnid (A, *Chl*). F, *Trochosa* embryo, longitudinal section of anterior end, showing position of frontal ganglion (*FrG*) (from Holmgren, 1920, somewhat simplified).

tennules of mandibulate arthropods (fig. 2 E, *Ant*), as they were formerly thought to be, nor are they the mandibles, as some arachnologists still persist in calling them. Functionally, the chelicerae might be said to be the "jaws" of the arachnid, but their action is remote from the mouth and consists of grasping, holding, tearing, crushing, or piercing.

Some students of arachnid embryogeny, as Laurie (1890) and McClendon (1904), say the definitive preoral position of the chelicerae results from a posterior displacement of the mouth, while Reuter (1909) says that as the mouth moves caudad there is a simultaneous forward movement of the chelicerae. Since the mouth and the labrum retain their primitive positions at the anterior pole of the animal, the result, however produced, is the same as if the chelicerae had migrated anteriorly and dorsally around the mouth. In most cases the chelicerae come to lie entirely above the level of the epistome (fig. 2 A), and so close together that they reduce the area of the primary embryonic head lobe between them to a narrow vertical strip.

The chelicerae have the same essential structure and musculature in both the Xiphosurida (fig. 3 A) and the Arachnida (C). They are composed of three segments in *Limulus* (A), Palpigradi, Scorpionida (B), Phalangida (C), and many Acarina; they are two-segmented in Solpugida (F), Pedipalpida, Chelonethida, Araneida (G), and some Acarina. The uniformly simple structure of the chelicerae precludes the possibility of determining the homology of the cheliceral segments with the segments of a leg. The terminal segment is the "movable finger," which, except in Araneida (G), is usually opposed by an immovable process. The movable finger may be dorsal on the supporting segment, or it may be ventral, and in some forms lateral. The cheliceral pincer resembles the chela of a chelate pedipalp, but the movable finger of the chelicera has always both an opening and a closing muscle (fig. 3 A, D, E, F, G), while the movable finger of a pedipalp chela has only a closing muscle (fig. 5 E). When the chelicera is three-segmented (fig. 3 A, C), the middle segment is strongly muscled from the basal segment. The extrinsic muscles of the chelicerae arise on the dorsum of the prosona (fig. 3 C), there being no cheliceral muscles corresponding with the ventral muscles of the other appendages.

The pedipalps and the legs.—The pedipalps are the second postoral appendages of the Arachnida; they are thus the homologues of the *mandibles* of mandibulate arthropods; but arachnologists commonly call them the "maxillae," or at least they give this term to the coxae,

which usually are closely associated with the mouth. Though Hansen and Sørensen (1904), therefore, are morphologically correct in designating the pedipalp coxae "mandibles," the term is not appropriate in a functional sense, inasmuch as the pedipalp coxae do not form true jaws in any arachnid. Arachnology has the term *pedipalp* for the second pair of segmental appendages, and, though the latter are

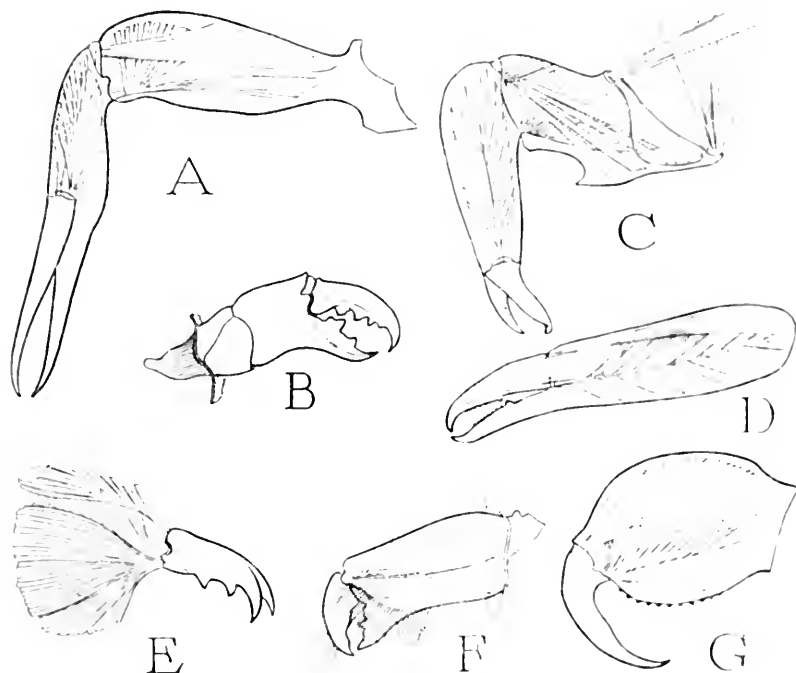


FIG. 3.—Structure and musculature of the chelicerae.

A, *Limulus polyphemus* L., Xiphosurida, left chelicera of a young specimen, lateral. B, *Pandinus* sp., Scorpionida, chelicera. C, *Leiobuonum* sp., Phalangida, left chelicera and muscles, lateral. D, same, distal segments of chelicera, showing both muscles of movable finger. E, *Centruroides* sp., Scorpionida, movable finger of chelicera and its muscles. F, two-segmented chelicera of a solpugid. G, two-segmented chelicera of a spider, *Eurypelma hentzi* Chamb., lacking a fixed finger.

not always palpiform, there would seem to be no good reason for calling them either maxillae or mandibles.

The coxae of the pedipalps in most of the arachnids are directed horizontally forward at the sides of the mouth (fig. 2A, *HCx*), and, as already noted, their dorsal surfaces are usually united with the epistome (*Epst*), which thus forms an intercoxal bridge. The lines of union are generally distinct grooves (*B, ccx*), which are

commonly inflected to form internal ridges or platelike *epistomocoxal apodemes* (B, *ecAp*). The coxal bases themselves may be produced into *coxal apodemes* (fig. 9 B, *cAp*) having lateral positions relative to the median epistomal apodeme (*eAp*) when the latter is present in the same species. Only in the Palpigradi do the pedipalps retain a postoral status and have no relation to the mouth (fig. 6 D, *Pdp*). It is of interest to note that in the mandibulate arthropods the mandibles have a relation to the epistome very similar to that of the pedipalp coxae to the epistome in the arachnids. In the pterygote insects with biting jaws, and the decapod crustaceans, for example, the mandibles have an anterior articulation on the epistome (clypeus), while the decapod jaw, in addition, has a long hinge line on the epistomal margin.

The telopodite of the pedipalp appendages may differ little from that of the legs, or it may be modified in various ways. Its adaptation in the male spider to form a sperm-carrying organ, having nothing to do with feeding, need not be considered here; but in the Scorpionida, Chelonethida, and some of the Pedipalpida the pedipalp is chelate, and with these arachnids the chelae become important adjuncts to the feeding function, since they serve for catching, holding, and crushing the prey. To understand the nature of the pedipalp chela it will be necessary to study the structure and musculature of the distal segments of an ordinary walking leg.

The simplest structure of the end segment of an arthropod limb is seen in the legs of malacostracan Crustacea in which the appendage terminates with a clawlike segment, called the dactylopodite, movable by levator and depressor muscles arising in the segment proximal to it, which is the propodite, or tarsus. The legs of *Limulus* have a similar structure (fig. 4 F) though here the dactylopodite, or pretarsus (*Ptar*), forms the movable finger of a chela. Among the Arachnida a simple, clawlike end segment of the leg occurs in some of the Phalangida, as in *Leiobunum* (B, *Ptar*); but more commonly the pretarsus of the walking legs bears a pair of lateral claws, or *ungues* (A, *Un*), while the median claw is reduced to a toothlike dactyl (*Dac*) on the short base of the segment. Whatever the structure of the pretarsus may be, however, two tendons are always attached to its base (A, B, *lvt*, *dpt*), one giving insertion to a levator (extensor) muscle, the other to a depressor (flexor) muscle. Even though the claws be greatly reduced or entirely absent, and the pretarsus become indistinguishable from the end of the tarsus, the two pretarsal tendons and their muscles may be retained, as in the slender first legs of Thelyphonidae. The levator muscle of the pretarsus in

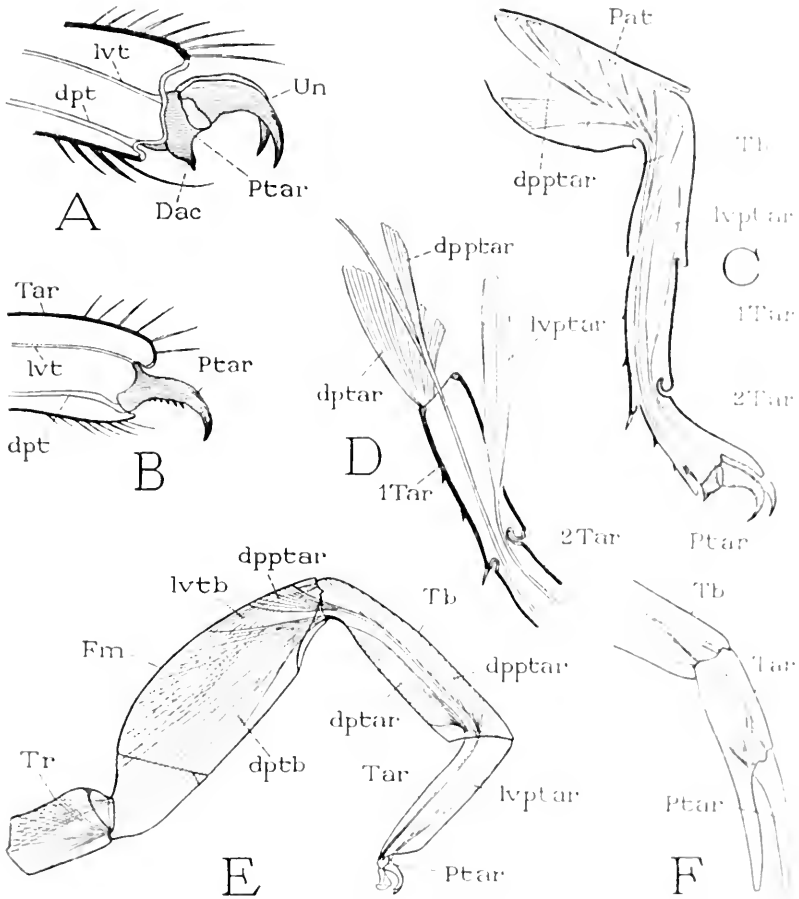


FIG. 4.—Segmentation and musculature of the arachnid leg, and pretarsus of *Limulus*.

A, *Mastigoproctus giganteus* (H. Lucas), Pedipalpida, end of a leg, pretarsus with a median claw (*Dac*) and two lateral claws (*Un*). B, *Leobonium* sp., Phalangida, end of pedipalp tarsus, with simple clawlike pretarsus. C, *Pandinus* sp., Scorpionida, distal segments of leg showing distribution of pretarsal muscles. D, *Centruroides* sp., Scorpionida, base of tarsus, showing presence of only a single tarsal muscle, a depressor (*dpptar*), arising in tibia. E, *Atumias politus* (Simon), Chelonethida, fourth leg and muscles, only one muscle (*dpptar*) on base of tarsus (from Chamberlin, 1931). F, *Limulus polyphemus* L., Xiphosurida, chela of a leg, both muscles of pretarsus arising in tarsus.

Dac, dactyl (median claw); *dpptar*, depressor muscle of pretarsus; *dpt*, depressor tendon of pretarsus; *dptar*, depressor of tarsus; *dptb*, depressor of tibia; *Fm*, femur; *lvptar*, levator of pretarsus; *lvt*, levator tendon of pretarsus; *lvtb*, levator of tibia; *Pat*, patella; *Ptar*, pretarsus; *Tar*, tarsus; *1Tar*, *2Tar*, first and second tarsal subsegments; *Tb*, tibia; *Tt*, trichapter; *Un*, unguis (lateral claw).

some arachnids arises in the tarsus (fig. 4 E, *lvptar*), in others it takes its origin in the tibia (C). The larger and stronger depressor muscle has no connection in the tarsus, but a branch of it arises in the tibia, and one or several branches in the patella (C, *dpptar*), unless a patella is absent, in which case the upper part of the muscle arises in the femur (E, *dpptar*).

The tarsus of an arachnid leg may be a simple segment (fig. 4 E, *Tar*), or it may be divided into two or more subsegments, or tarsomeres (C, *1Tar*, *2Tar*). No muscles are ever present between tarsomeres. It is important to note, furthermore, that the tarsus itself has only one muscle, a depressor, which arises in the tibia (D, E, *dptar*). The character of the distal musculature of the leg, therefore, will serve to identify the pretarsus, the tarsus, and the tibia when the identity of these segments is not otherwise clear.

The chelate arachnid pedipalp (fig. 5 D) has only six segments, of which the last is the movable finger of the chela, and might therefore appear to be a clawlike pretarsus. A study of the musculature, however, shows that the finger is movable by *only one muscle*, and that one a depressor (E, G, *dptar*), which thus corresponds with the single muscle of the tarsus of a leg (fig. 4 D, E, *dptar*). In the nonchelate pedipalp of one of the amblypygous Pedipalpida, *Trithyreus* (fig. 5 A), it is shown by Börner (1904) that the small pretarsus (*Ptar*) has the usual pretarsal musculature (*lvptar*, *dpptar*). In the Thelyphonidae of the same order the pedipalp is chelate (C) and there is no distinct pretarsus, but attached within the apex of the movable finger Börner finds the tendon of a depressor muscle, from which fact he logically contends that the movable finger is the tarsus and pretarsus combined. According to Barrows (1925) two tendons are attached in the pedipalp finger in *Mastigoproctus* (B), one giving insertion to a small muscle arising in the proximal segment (*Tb*), the other to a muscle from the next segment (*Pat*). Some over-hardened specimens of *Mastigoproctus* examined by the writer appear to confirm Barrow's statement. By comparison with a leg, therefore, the movable finger of the pedipalp chela is the combined tarsus and pretarsus (B-G), and the proximal segment, or "hand," containing the single depressor muscle of the finger, is the tibia (*Tb*), while the segment supporting the chela is the patella (*Pat*). Both Börner and Barrows regard the basal segment of the chela as a proximal segment of the tarsus, but this interpretation is clearly not in accord with the musculature, since the single muscle of the finger is evidently the tarsal muscle of a leg, and tarsal subsegments are never interconnected by muscles.

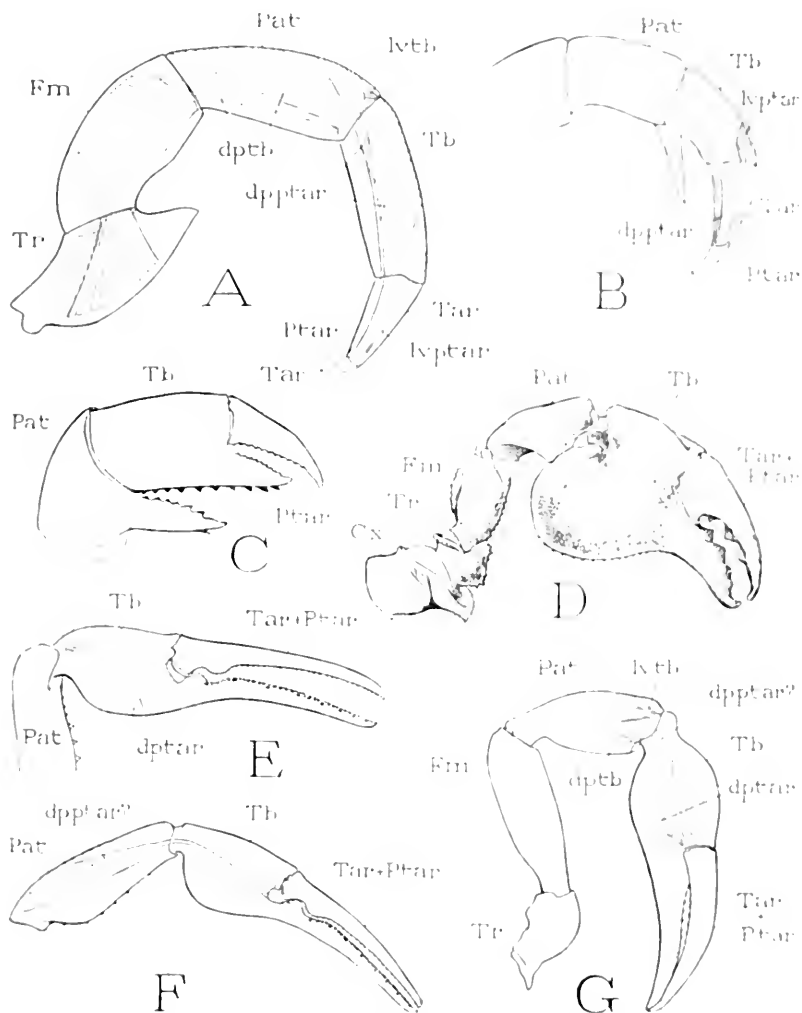


FIG. 5.—Segmentation of the chelate pedipalp.

A, *Trithyreus cambridgei* (Thor), Pedipalpus-Uropygi-Schizopeltidia, pedipalp and muscles (from Börner, 1904, but "tibia" and "first tarsal segment" of Börner here interpreted as patella and tibia respectively). B, *Masiogoproctus giganteus* (H. Lucas), Pedipalpus-Uropygi-Holopeltidia, distal segments of pedipalp (from Barrows, 1925, but "tibia" and "metatarsus" of Barrows here interpreted as patella and tibia). C, same, patella and chela of pedipalp. D, *Pandinus* sp., Scorpionida, pedipalp. E, *Centraroides* sp., Scorpionida, chela, showing depressor muscle of tarsus in basal segment. F, same, showing muscle from patella to base of movable finger. G, *Dasycheres inpalms* Chamb., Chelonethida, pedipalp (from Chamberlin, 1931, but "tibia" of Chamberlin interpreted as the patella).

Lettering as on figure 4.

In the scorpion (fig. 5 E) the basal segment of the chela (*Tb*) contains a great mass of depressor muscles (*dptar*) of the movable finger, divided into three distinct bundles of fibers, two of which are lateral and one ventral. Above the ventral muscle runs a strong median tendon (F), attached distally on the base of the finger, and giving insertion proximally to a large, dense, fusiform muscle (*dpptar?*) in the patella (*Pat*). Functionally this muscle is an effective depressor of the finger, but its origin in the patella suggests that it represents the patellar branch of the depressor of the pretarsus in the scorpion leg (fig. 4 C, *dpptar*). A similar muscle is shown by Chamberlin (1931) to be present in the pedipalp of the pseudoscorpion (fig. 5 G, *dpptar?*).

The mouth and the preoral cavity.—The mouth of an arthropod embryo lies between the base of the labrum and the venter of the first postoral somite. Though a labrum is almost always present and overhangs the mouth, the sternal region of the postoral somite is seldom to be identified in the adult structure.

In the arachnid order Palpigradi the mouth is on the end of a snoutlike cone projecting from between the bases of the chelicerae (fig. 6 B, D), and the pedipalps are entirely postoral in position (D, *Pdp*). The mouth cone is formed by a dorsal plate, clearly the labrum (*Lm*), and a similar ventral plate. The ventral plate cannot possibly be referred to the segment of the postoral pedipalps, and is therefore most reasonably regarded by Börner (1902) as the sternum of the cheliceral segment (*IS*), retained in the Palpigradi, but lost, or not recognizable as such, in any other arachnid.

Among the other arachnid orders there is nearly always present an under-lip structure, but it never corresponds with the suboral plate of the Palpigradi. In the Araneida the functional under lip is the projecting sternum of the pedipalp segment; in the Phalangida it is the sternum of the first leg segment; in the Scorpionida it is formed by coxal lobes of the first and second legs; in the Thelyphonidae and Ricinulei it is the united coxae of the pedipalps; in most of the Acarina it is a long lobe, known as the hypostome, produced from the united pedipalp coxae. In these orders the pedipalp coxae are turned forward at the sides of the mouth so that there is enclosed a preoral cavity between the labrum above, an under lip below, and the pedipalp coxae on the sides.

That the external feeding organs of the Arachnida constitute a "beak," or are derived from such a structure, seems to be an idea prevalent with many writers. Bernard (1895, p. 391), for example, in discussing what he calls the "beak" of the Solpugida, says: "The

possession of this organ in such diverse Arachnids as *Galeodes*, *Chernes*, and *Thelyphonus*, and the easy deduction of the mouth-parts of Spiders, *Scorpio* and *Phrynus*, from such an organ, render it almost certain that a beak was present in the original Arachnid." Pocock (1902), on the other hand, rejects this idea. He shows that the so-called "beaks" in the different arachnid orders do not have the same composition, and he points out "that there is no difficulty in regarding all these various kinds of 'beaks' as specialized organs resulting from the presence of a camarastome or labrum, and the need for a lower lip or suboral gutter to prevent the loss of nutritive fluids and to guide them into the alimentary canal." The labrum overhanging the mouth, Pocock contends, is the primary structure associated with the oral aperture, since a labrum in some form is found in all the arachnids. The lower lip, on the other hand, is a secondary structure, as is shown by the different ways in which it is formed (as above enumerated). The association of the pedipalp coxae with the upper and lower lips then completes whatever may be called a "beak," or "rostrum," but clearly the structure thus composed is a secondary formation adaptive to the liquid-feeding habits of the arachnids.

The intercoxal antechamber of the mouth is an important part of the arachnid feeding apparatus, and becomes variously modified in the several orders; it serves for the reception of food from the chelicerae, and as a mixing bowl with those arachnids that practice extraoral digestion. This preoral food chamber, however, is not a "buccal cavity," "buccal canal," or "Mundhöhle," as it is commonly called, since a buccal cavity, in any proper anatomical sense, should be within the mouth and not outside of it. The arachnid food receptacle is a *preoral cavity*, so termed by Pavlovsky and Zarin (1926), or the "Mundvorraum" of some German writers. It is entirely comparable to the preoral food cavity of an insect between the enclosing mouth parts.

The sucking organ, or so-called pharynx.—The mouth of the arachnid (fig. 2 D, *Mth*), lying at the inner end of the preoral cavity beneath the base of the labrum, opens directly into the sucking apparatus known as the *pharynx* (*Phy*). This organ varies much in size and shape in the different arachnid orders, but it is always provided with dilator muscles, and usually with constrictor muscles, and thus is capable of a sucking action. The dilators include dorsal and lateral or ventrolateral groups of fibers converging on the pharyngeal walls (fig. 2 B, *Phy*). The dorsal dilators (*D, ddl*) always take their origins on the epistomal plate (*Epst*) or on a basal apodeme of the epistome; the lateral dilators arise on apodemal inflexions between the epistome

and the pedipalp coxae (B, *ccAp*), on apodemes of the coxae, or on the coxal walls.

The sucking organ of the arachnids, with its dorsal dilator muscles arising on the epistome, is suggestive of the sucking pump of liquid-feeding insects, with its dilator muscles arising on the clypeus. Furthermore, the organ in each case is *anterior* to the frontal ganglion and its brain connectives. The frontal ganglion of the arachnid lies on the dorsal surface of the oesophagus (fig. 2 F, *FrG*), but since the oesophagus (*Oe*) penetrates the central nerve mass, the ganglion, as shown by Holmgren (1920) and by Hanström (1928), is buried within the surrounding tritocerebral lobes of the brain (F, *IG*).

The usual sucking organ of the insects, with dilator muscles from the clypeus, is *not the pharynx*; it is a derivative of the preoral food cavity, while the true pharynx is a part of the stomodaeum and lies behind the frontal ganglion. The sucking organ of the arachnids is usually said to be the first part of the stomodaeum, and is therefore called the pharynx. According to Wagner (1894), however, the sucking apparatus as developed in *Ixodes* is a secondary invagination added to the primary stomodaeal invagination, "ein neues Theil des Stomodaeums, welcher die Anlage für den Saugapparat bildet," the walls of which become hardened and give attachment to the dilator muscles. The primary stomodaeal invagination, Wagner says, forms the narrow oesophagus. There is therefore reason to believe that the so-called pharynx of the arachnids is a secondary derivative of the preoral cavity, as is the preoral cibarial sucking pump of the insects. Though the arachnid organ is usually well differentiated in structure from the functional preoral cavity, it is in some cases, as in the Thelyphonidae and Araneida, practically continuous with the latter, and in the Chelone-thida most of the dilator muscles arising on the epistome are inserted on the dorsal wall of the preoral cavity. To avoid confusion with current nomenclature, however, we may continue to call the sucking organ of the arachnids the "pharynx."

The oesophagus is always a narrow tube, which, after leaving the pharynx, traverses the central nerve mass on its way back to the mesenteron. Just before entering the latter it usually enlarges to form a small second, proventricular sucking organ, the so-called "stomach pump," or "Saugmagen."

Comparison of Arachnida and Xiphosurida.—A comparison of the arachnids with the xiphosurids shows that there is little in common between the two groups with respect to the feeding organs or the method of feeding. In the Xiphosurida the coxae of the first five pairs of postcheliceral appendages have large spiny mesal lobes op-

posed to each other from opposite sides in such a manner as to enclose a triangular space between them with the mouth at its apex. The coxal spines converge forward toward the oral aperture. The food of the xiphosurids consists principally of worms and small mollusks. The prey is said by Lockwood (1870) to be grasped by the leg pincers and brought beneath the body, where it is lodged between the coxae. The coxae then close against it from the sides and with their spines push it forward to the mouth, into which it is inserted by the legs. Lockwood says the food is rasped and comminuted by the coxal spines, but Schlotke (1935) observes that when *Limulus* is fed pieces of fish, the pieces are gulped down entire, though he admits that shellfish may be crushed by the coxae. In any case, the ingested food is ground up in a strong proventricular gizzard before it is passed into the stomach.

By contrast with the xiphosurids the Arachnida are essentially liquid-feeders. The prey is caught by the chelicerae, or the pedipalps if these appendages are chelate, crushed or lacerated, and held in the chelicerae while the exuding body liquids are sucked out. The arachnids have no chewing organs. The pedipalp coxae, or also the coxae of the first legs, may have lobes functionally associated with the mouth, but they are not masticatory in function, nor do they resemble the coxal lobes of *Limulus*. In the Palpigradi there are no such lobes, and the pedipalps are entirely postoral. If, therefore, the palpigrade mouth structure represents a primitive condition among the Arachnida, as it appears to do, the arachnid feeding apparatus has been evolved quite independently, and has no relation to the feeding organs of modern Xiphosurida. All the arachnids have an efficient sucking pump for the ingestion of liquids, but they have no grinding organ such as the gizzard of *Limulus*. In general, only food in liquid form can pass the arachnid ingestion apparatus, since usually the entrance is guarded by straining fringes of hairs, and the oesophagus is a very slender tube from the pharynx to the stomach; blood corpuscles and spores, however, may be carried in suspension, and in the phalangiids, it is said, even hard fragments of the food are to be found in the stomach. With some of the arachnids, particularly the Araneida, the availability of the tissues of the prey is increased by the practice of extraoral digestion. The arachnids possess salivary glands, and large excretory organs, the so-called "Malpighian vessels," discharging through the anus; the xiphosurids have no salivary glands, and no excretory organs connected with the alimentary canal.

Considering the differences above enumerated between the Arachnida and the Xiphosurida, it is evident that the two groups represent

separate lines of evolution within the Chelicerata, and that the arachnids have not been derived from any *Limulus*-like progenitor. The xiphosurids, on the other hand, show unmistakable affinities to the trilobites, whose habits of living must have been similar to those of *Limulus*.

The stomach and digestion.—The greater part of the food tract of the arachnids is formed from the mesenteron, including the stomach proper, the anterior part of the intestine, and the excretory vessels known as “Malpighian tubules” that open with the intestine into a terminal proctodaeal cloaca. The stomach consists of a central canal and of radiating diverticula, which latter may be few and sacklike, or numerous and tubular. The earlier workers on the digestive processes of Arachnida, including Plateau (1877) and Bertkau (1884), regarded the stomach diverticula as digestive glands, but it was shown by Bernard (1893) and Berlese (1897) that the diverticula constitute the digestive region of the stomach. These writers, furthermore, claimed that digestion with the Arachnida takes place *intracellularly* in the epithelium of the diverticula, and their contention has been substantiated by the more detailed studies of later investigators, including Oetcke (1912), Roesler (1934), Schlottke (1934), Bader (1938), and Frank (1938). Pavlovsky and Zarin (1926) showed that the digestive enzymes in the scorpion, including amylase, lipase, and proteinases, are formed only in the stomach diverticula.

The epithelium of the stomach diverticula consists of two distinct kinds of functionally active cells; namely, *secretory cells*, or “ferment” cells, and *digestive cells*. Prior to feeding, the secretory cells are filled with globules of secretion products; the digestive cells are practically devoid of inclusions. After feeding, the secretory cells discharge their contents into the lumina of the diverticula, while the digestive cells soon begin to show loose masses of material in their cytoplasm, which later condense into dark-staining globules. In a starved animal, secretion products are again formed in the secretory cells, but the globules of the digestive cells gradually disappear. From these histological phenomena it is deduced that the globules formed in the digestive cells are masses of ingested food material, which is finally digested in the cells and absorbed. Confirmatory evidence is seen in the fact that granules of excretory matter accumulate in the distal parts of these cells, which in most cases are discharged into the stomach lumen by constriction and separation of the ends of the cells. In those Acarina that have no intestinal outlet from the stomach, the excretory granules remain in the epithelial cells.

Different investigators are not entirely in accord as to the part

played in digestion by the secretion of the secretory cells. Oetke (1912) believed that the tissues of the prey are first dissolved by secretion of the salivary glands, and that the liquefied food is then taken into the digestive cells, where it is digested by the digestive secretion absorbed from the secretory cells. According to Roesler (1934), Schlottke (1934), Frank (1938), and Bader (1938), however, a preliminary digestion by enzymes from the secretory cells takes place in the lumina of the diverticula, after which the process is completed within the digestive cells (presumably by enzymes formed in the latter). It thus appears that only the final phase of digestion is intracellular.

The digestive processes of *Limulus*, as described by Schlottke (1935), are similar to those of the Arachnida. After the food has been ground up in the proventricular gizzard it is passed into the central lumen of the stomach, where it is deluged with digestive fluid from the many-branched diverticula, containing protease, carboxypolypeptidase, amylase, and lipase. In a state of "predigestion" the liquefied food is then forced into the end branches of the diverticula and absorbed by the digestive cells, within which a dipeptidase completes the process of digestion. Similarly in the Pycnogonida Schlottke (1933a) has shown that digestion takes place intracellularly in the absorptive cells of the stomach diverticula. The ingested food of the pycnogonids, however, Schlottke says, contains no particles and no recognizable fragments of the tissues of the prey, a fact suggesting that the secretion cells of the stomach, which become active before feeding, must play some part in the liquefaction of the food, since the filtering apparatus of the stomodaeum could hardly be supposed to reduce the food to a liquid condition by mechanical action.

Some arachnids, particularly the Araneida, are well known to practice extraoral digestion. The solvent fluid discharged from the mouth has been generally supposed to be a product of the salivary glands, but the amount of the liquid exuded from the mouth is often so great that it would seem more probable, as contended by Kästner (see Gerhardt and Kästner, 1937), that it comes from the stomach diverticula.

II. THE PALPIGRADI, OR MICROTHELYPHONIDA

The members of this order, comprising about 20 known species, are minute creatures, mostly tropical or subtropical in distribution, with species in the Mediterranean region of Europe, and in Texas and California of the United States. The pedipalps of these arachnids

(fig. 6 A) are leglike and have no association with the mouth; the first legs are long and slender; the relatively large, segmented abdomen terminates in a multiarticulate flagellum. The name Palpigradi approximately expresses the fact that the palps are leglike and used for walking; the name Microthelyphonida implies a resemblance to the Thelyphonidae of the Order Pedipalpida in the possession of a jointed tail, but otherwise there is no likeness between the two groups. Though the second name antedates the other by a matter of two years, the first is preferable for brevity and significance.

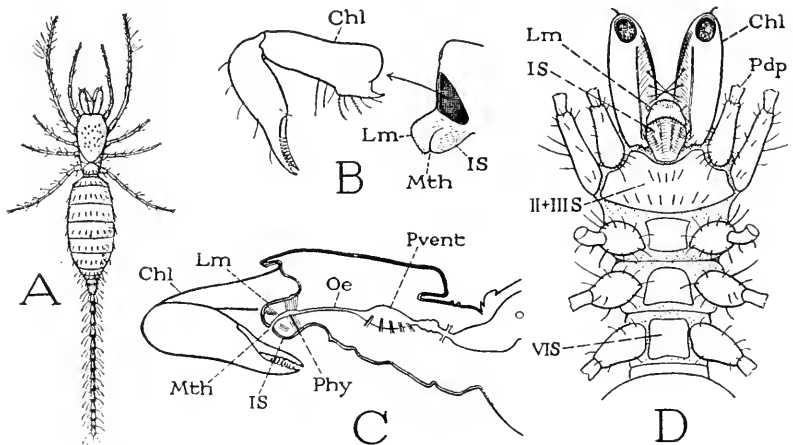


FIG. 6.—Palpigradi.

A, *Koenenia mirabilis* Grassi (from Hansen and Sørensen, 1897). B, same, anterior end of body with mouth cone and detached left chelicera (from Hansen and Sørensen, 1897). C, *Prokoenenia wheeleri* (Rucker), median section through mouth cone and prosoma (outline from Rucker, 1901). D, *Koenenia mirabilis* Grassi, prosoma and bases of appendages, ventral (from Börner, 1901).

The structure of the palpigrades is known principally from the work of Hansen and Sørensen (1897), Börner (1901, 1902), Wheeler (1900), and Rucker (1901, 1903). The last two writers record also something of the habits of *Prokoenenia* (*Koenenia*) *wheeleri* (Rucker). Wheeler suggested that this species, found in Texas, feeds on the eggs of *Campodea* and *Japyx*, with which it is associated in nature under stones where there is a sufficient degree of moisture; Rucker (1903) says that the alimentary canal contains nothing but material resembling yolk particles, and is "admirably constructed for such an illegitimate practice as egg-sucking."

With respect to the feeding organs the Palpigradi are the simplest of the arachnids. The relatively large, three-segmented chelicerae (fig. 6 B, *Chl*) arise at the base of a snoutlike cone bearing the mouth

(*Mth*), and are thus but little preoral in position. The leglike second appendages, corresponding with the pedipalps of other arachnids, lie entirely behind the mouth (*D. Pdp*), and are connected with a large ventral plate (*II+IIIS*) that would appear to be a combination of the deutosternum and the tritosternum, since it bears both the second and the third pairs of appendages. The pedipalps are said by Rucker (1901) to be used in common with the posterior three pairs of legs as locomotor organs, while the long slender first legs are held aloft and waved about in the manner of palps. The pedipalp coxae, having no association with the mouth, are in no way involved in the function of feeding.

The snoutlike cone that bears the mouth of the palpigrades (fig. 6 B, *Mth*) has no duplicate in any other arachnid order. The part above the transverse mouth slit is evidently the labrum (*Lm*), or labrum and epistome. The suboral part (*IS*) is interpreted by Börner (1902) as the prosternum, that is, the sternum of the cheliceral segment; there is, in fact, no other structure to which it might be referred, and the close association of the chelicerae with the base of the cone is entirely in harmony with this view. If, therefore, the mouth of the palpigrades lies between the labrum and the sternum of the first post-oral somite, we see here an embryonic condition retained in no other modern adult arthropod. The complete dissociation of the pedipalps from the mouth, Kästner (1932b) says, is known otherwise than in the Palpigradi only in the Jurassic fossil arachnid *Sternarthron* of Haase (1890). Haase, himself, regarded the likeness of *Sternarthron* to the living Palpigrada as so close that he included it in this order.

The mouth cone of the Palpigradi suggests the proboscis of the Pycnogonida, which projects below the chelicerae and between the pedipalps, but the pedipalps arise, as in the Palpigradi, from a sternal plate behind the base of the proboscis. The pycnogonid proboscis, however, has an elaborate innervation from a number of apical ganglia that are connected dorsally with the brain by a single nerve trunk, and ventrally with the suboesophageal ganglion by two nerve trunks (see Wirén, 1918, and Hanström, 1928). If the apical ganglia, as Hanström contends, represent the frontal ganglion, this ganglionic complex of the pycnogonids has quite a different relation to the stomodaeum within the proboscis than has the frontal ganglion of the arachnids. Moreover, the innervation of the lower half of the pycnogonid proboscis from the pedipalp centers of the suboesophageal ganglion does not conform with the idea that this part of the organ represents the sternum of the cheliceral segment. It seems probable, therefore, that the pycnogonid proboscis is a structure independ-

ently developed, and unrelated to the mouth cone of the Palpigradi.

If the mouth structure of the Palpigradi really is primitive for the arachnids, then there can be no direct relationship of the Arachnida to the Xiphosurida, and the coxal lobes of the higher arachnids must have been developed quite independently of those of the xiphosurids.

The mouth of *Prokoenenia wheeleri*, Rucker (1901) says, "leads into a strongly-chitinized pharynx (fig. 6 C, *Phy*). This in turn runs into a very delicate oesophagus (*Oe*) which penetrates the cephalothoracic nerve mass, only to dilate immediately into a pouch-like sucking stomach" (*Pvent*). The pharynx is shown in one of Rucker's figures to have dilator muscles arising dorsally on the upper wall of the mouth cone, and ventrally on the lower wall. According to Börner (1902), the walls of the pharynx contain a dorsal plate, which is the under surface of the labrum, and a ventral plate, which is the upper surface of the suboral prosternum. The "pharynx" of the Palpigradi would thus appear to be a specialized preoral cavity; yet Kästner (1932b) ascribes it to the stomodaeum (Vorder-Darm).

III. THE SOLPUGIDA

Most conspicuous of the feeding organs of the solpugids are the huge, two-segmented chelicerae (fig. 7 C), directed straight forward from the anterior section of the body (A), which latter appears to be constructed particularly for their support, though it carries also the pedipalps and the first pair of legs. The solpugids are said to employ principally the last three pairs of legs for locomotion, the first legs being often used as accessories to the palps for catching and holding the prey. The coxae of the pedipalps and those of the first legs are firmly united on each side (B, *IICx*, *IIICx*), and the two pairs are supported on a single T-shaped sternal plate, which would appear to represent the deutosternum and the tritosternum combined. The narrow, deeply channeled anterior part of the plate (*IIS*) lies between the pedipalp coxae; the posterior part is a transverse bar (*IIIS*) behind the first leg coxae. The following three sterna are individual plates, though each is divided by a median groove that forms an internal ridge. That these plates are sterna and not the coxae of the legs is shown by the presence of large apodemal structures arising from them, and by the fact that the legs have a full complement of segments, including two trochanters.

The pedipalps arise entirely behind the mouth region (fig. 7 B), as they do in the Palpigradi, but in the solpugids their large coxae diverge forward beneath the chelicerae (B), and each is produced

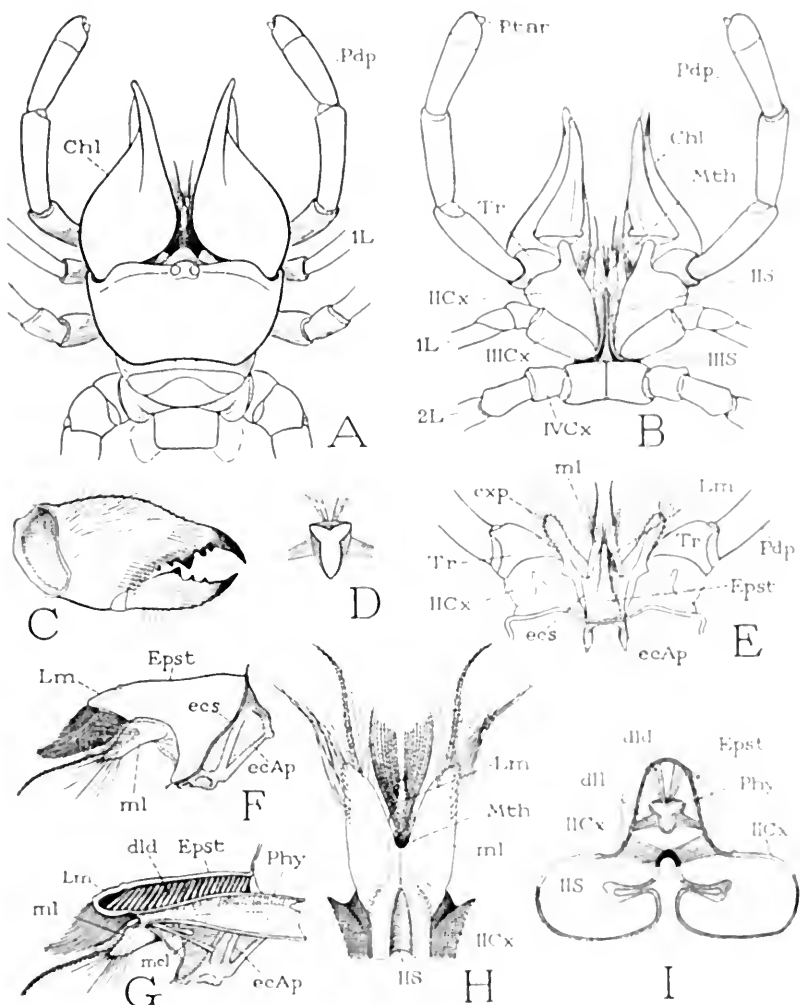


FIG. 7. — *Solpugella quadridentata* Snodgrass.

A, prosoma and appendages, dorsal. B, anterior part of same, ventral. C, left chelicera, mesal. D, cross section of posterior part of pharynx, with muscles. E, mouth region and bases of pedipalps, dorsal. F, epistome and labrum detached from pedipalpal coxae, exposing epistomocoxal apodeme (*ecAp*) of left side. G, median longitudinal section through epistome, labrum, and pharynx. H, mouth region, ventral. I, cross section through epistome, pedipalpal coxae, and anterior part of pharynx.

into a thick, blunt process (E, *cxp*) projecting mesad of the trochanter (*Tr*). The coxal processes, however, would appear to have no particular function in connection with feeding. The dorsal surfaces of the coxae (E, *IICx*) are mostly membranous, but mesally where they join the epistome (*Epst*) each is strongly sclerotized in continuity with the upper surface of the anterior coxal process.

The telopodite of each pedipalp (fig. 7 B, *Pdp*) includes five thick, cylindrical, hairy segments, and an eversible adhesive end organ (*Ptar*). The end organ is an invaginated sack eversible from between two outer, hairless lips, the structure and mechanism of which has been fully described by Sørensen (1914), by Barrows (1925), and by Kästner (1933b). With each organ are associated the tendons of two muscles, one attached on the inner end of the sack, the other on the lower lip of the outer opening. The everted sack, supposedly forced out by blood pressure, assumes the shape of a stalked, cuplike pad; the muscles effect its retraction. These end organs of the pedipalps are evidently the pretarsi, the sacks being probably, as Sørensen says, the homologues of the plantulae, or empodia, of the walking legs. The everted pads are said to be adhesive organs which enable the solpugids to climb on smooth vertical surfaces, and Heymons (1901) asserts that they are used also for catching small insects, which adhere to their exposed surfaces.

Between the dorsal surfaces of the pedipalp coxae is a large, strongly convex epistomo-labral plate (fig. 7 E, *Epst, Lm*), the labral part of which projects as a free lobe between the divergent coxal processes (*cxp*). The labrum of the solpugid is not separated from the unusually long epistome (E, F), and some writers have regarded the whole plate as the labrum. However, since the proximal part of the plate (*Epst*) is united laterally with the mesal sclerites in the dorsal walls of the pedipalp coxae (E, *IICx*), and gives origin to the dilator muscles of the pharynx (G, I, *dld, dll*), this part has the distinctive features of an epistomal plate. Along the lines of union with the coxal sclerites (E, F, *ccs*) are inflected a pair of large, plate-like epistomo-coxal apodemes (E, F, *ccAp*) that extend proximal to the base of the epistome.

The relatively small labrum (fig. 7 E, *Lm*) projects as a free lobe from the end of the epistome, and conceals the mouth below its base (G). On its under surface the labrum bears two large, flat, closely adjacent brushes of long thick hairs beset with many small, delicate barbules, and united by transverse bars (F, G, H), so that each brush forms a fine-meshed sieve. Since these labral brushes guard the mouth behind them (H, *Mth*), they appear to constitute a filtering

apparatus for straining out particles of food too large to be swallowed.

The mouth of the solpugid (fig. 7 H, *Mth*) lies above the edge of a membranous ventral area in front of the tapering anterior end of the narrow deutosternum (*IIS*). Diverging at the sides of the mouth from this membranous area is a pair of large, flat, soft lobes (*ml*) with long apical setae, and each lobe bears a slender, finely hairy flagellum. These mouth lobes are characteristic features of the solpugids. Laterally each lobe lies adjacent to the free margin of the epistomal plate (*F*). The two mouth lobes, together with the labrum and the setal brushes, guard the entrance to the mouth, but they can hardly be said to form a preoral cavity. The gutterlike deutosternum (*B*, *H*, *I*, *IIS*) is deeply buried between the mesal surfaces of the pedipalp coxae (*I*, *IICx*), and its tapering anterior end (*H*) runs out into a shallow median groove that goes forward to the lower margin of the mouth. Possibly this sternal channel also has something to do with the oral conduction of food liquids.

The unusually large size of the epistomo-labral plate of the solpugids gave the earlier writers on these arachnids the idea that the solpugid mouth parts constitute a "beak." Bernard (1895), for example, says, "the beak is a marked feature of the Galeodidae"; he contended, furthermore, that a beak is a primitive arachnid structure, best preserved in the Solpugida, but variously reduced in the higher orders. Börner (1902) refers to the Solpugida and the Palpigradi as the only arachnids in which the mouth opening is situated on a cone, or so-called rostrum. What these writers call a beak, Police (1928) terms the "bucco-pharyngeal apparatus." The present writer sees no reason for regarding the mouth-bearing part of the solpugid as a "beak" or "rostrum" in any true sense. Only the labrum projects as a free lobe dorsally, with the mouth beneath its base as in other arachnids, and the ventral mouth lobes are special features of the solpugids. Police (1928) contends that the mouth lobes of the solpugids are homologues of the lobes of the pedipalp coxae in Phalangida and Araneida, which interpretation he says follows from Heymons' (1905) observation on their development. Heymons, however, says merely that the lobes develop mesad of the coxal processes of the pedipalps; there is little to suggest that they have any homology with coxal lobes of other arachnids.

The pharynx of the solpugids is an elongate sack (fig. 7 G, *Phy*) with soft walls devoid of sclerotic plates. In cross section it is triangular, but the walls are inflected between the angles, forming a three-pointed star (*I*, *Phy*). Posteriorly the lower lobe becomes much longer than the upper lobes (*D*). Dorsal dilator muscles of the

pharynx arise along the entire length of the epistome (*G, dld*) ; lateral dilators arise anteriorly on the epistome (*I, dll*), but posteriorly they spread to the epistomo-coxal apodemes. Constrictor fibers attached on the three pharyngeal ridges (*D*) alternate with the dilator fibers.

The solpugids are known to be voracious feeders on all kinds of insects, and it is well attested that larger species will attack, kill, and devour small vertebrates. It is recorded by Hutton (1843) that an Indian species of *Galeodes* $2\frac{1}{2}$ to $2\frac{3}{4}$ inches long kills and eats small lizards; Heymons (1901) says of *Galeodes caspius* that this species in captivity will eat small toads and lizards 2 to 3 cm. in length, and that a female in the open was seen feeding on a snake that had been killed by a railway train. The huge chelicerae are able to crush even the hardest beetles. In the case of large prey, Heymons observes, the solpugid first bites a hole in the body, and then tears out the soft inner parts until there is nothing left but the empty body wall. Smaller and weaker insects are directly chewed to a pulp in the chelicerae and the hard parts discarded. The fluid extracted from the prey presumably flows down between the chelicerae to the labrum, where it is filtered through the sieve brushes to keep large particles from reaching the mouth. The food is not known to be subjected to extraoral digestion.

The solpugids have often been accused of being venomous, but the chelicerae contain no poison glands, and the bite of a solpugid has been shown experimentally to be nonpoisonous, though admittedly the chelicerae might carry infective matter.

IV. THE PEDIPALPIDA

The name of this order is derived evidently from the fact that the "first legs" are long, slender, palplike appendages, in some forms so attenuated as to be almost filamentous, and have a sensory function. The so-called pedipalps, on the other hand, are strong prehensile organs and may be chelate. In one of the two principal groups of the pedipalpids, the Amblyphygi, the abdomen is broad and rounded; in the other, the Uropygi, it is more elongate and bears a caudal flagellum, which is either short (*Schizopeltidia*), or long and multiarticulate (*Holopeltidia*). The mouth parts are characteristically different in the two major groups.

With respect to the feeding organs the Amblyphygi are distinctly more generalized than the Uropygi. In each group the pedipalp coxae are extended forward far beyond the mouth; in the Uropygi they are united to form a preoral food trough, in the Amblyphygi

they are free from each other except at their bases (fig. 8 A, *IICx*) and the distal ends form a pair of large hairy processes (*cxp*). The labrum of the Amblypygi is a very small lobe overhanging the mouth (A, B, *Lm*). There is no distinct epistome, but a large, median epistomal apodeme is present (B, *eAp*) between a pair of lateral apodemes produced from the bases of the pedipalp coxae (A, B, *cAp*). The oral aperture beneath the labrum (B, *Mth*) opens directly into a simple, tubular pharynx (*Phy*), which in cross section is triangular and resembles the pharynx of the Solpugida. Dorsal dilator muscles of the pharynx arise on the epistomal apodeme, lateral dilators take their origins on the coxal apodemes (A, *Phy*). Because of the independence of the pedipalp coxae, and the small size of the labrum,

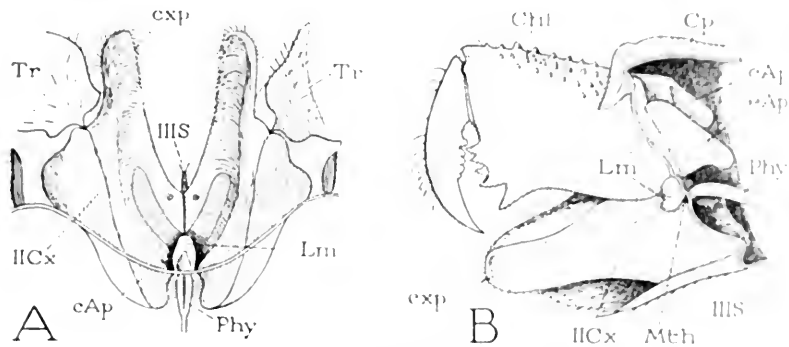


FIG. 8.—Pedipalpa-Amblypygi.

A, *Titanodamon johnstoni* (Poc.), Phrynidae, showing separation of pedipalp coxae, well-developed coxal processes (*cxp*), relatively small labrum (*Lm*), and simple pharynx (*Phy*) (from Pocock, 1902). B, *Phrynichus bacillifer* (Gerst.), Phrynidae, longitudinal section through anterior end of body a little to left of median plane (from Börner, 1904).

the Amblypygi have no distinct preoral food cavity; the Uropygi, on the other hand, have a highly specialized prepharyngeal food passage between the large, thick labrum above and the trough of the united pedipalp coxae below.

The Uropygi include the "whip-tailed scorpions" (Thelyphonidae), well known from the East Indian *Thelyphonus* and the American *Mastigoproctus*. The following description of the mouth parts is based on *M. giganteus* (H. Lucas) of the southern United States.

The membranous anterior wall of the body of *Mastigoproctus* is set far back under a long, overhanging part of the carapace, the lower surface of which is strongly sclerotized and bears a median keel. Beneath this projection of the carapace, at the sides of the keel, arise the relatively short, two-segmented chelicera, the movable fingers of which

are dorsal in the Pedipalpida (figs. 8 B, 9 C). Below the chelicerae is a broad horizontal surface formed of a median epistomal plate (fig. 9 B, *Epst*) flanked by the large dorsal plates of the pedipalp coxae (*dplcx*). The epistomal plate is divided by a median groove, and from its end projects the elongate, tapering, hairy labrum (*Lm*) between the setigerous mesal surfaces of the anterior processes of the pedipalp coxae (*cxp*). At the base of the epistome there extends into the body cavity a strong apodemal arm (B, D, *eAp*), which, as shown by its muscle connections, is clearly the epistomal apodeme of other arachnids, though in the Thelyphonidae, as noted also by Pocock (1902), it is not connected with the base of the epistomal plate ("clypeus" of Pocock), but arises from the body wall just above the epistome.

The pedipalp coxae present ventrally broad, flat surfaces (fig. 9 A, *IICx*) in contact with each other for most of their length, there being no evident remnant of the deutosternum between them. Anteriorly, however, the coxae are produced into a pair of thick, widely divergent, triangular processes projecting mesad of the trochanters. The dorsal surface of each coxa, as above noted, contains a large plate (B, *dplcx*) united mesally with the epistome, and continuous anteriorly into the coxal lobe (*cxp*). Laterally the coxal plate bears the dorsal articulation of the trochanter (*Tr*), but behind the trochanter it is separated from the sclerotic lateroventral coxal wall by a membranous gap, and its posterior mesal angle is produced into a tapering apodemal process (B, D, E, *cAp*). The united parts of the pedipalp coxae of *Mastigoproctus* extend beyond the tip of the labrum (B), and form under the latter a deep trough (*PrC*), the lateral walls of which are membranous and densely clothed with hairs converging downward beneath the labrum. The cavity thus enclosed is the anterior, open part of a preoral food passage leading back to the sucking organ. The posterior part of this passage has a highly specialized type of structure not known in any other group of arachnids.

The ingestion apparatus of the Thelyphonidae has been described by several writers, including Bernard (1893), Börner (1901, 1904), and Kästner (1932a), but it is most clearly portrayed by Pocock (1902). At the inner end of the open cavity between the labrum and the trough of the united pedipalp coxae is a semicircular slit concave dorsally. From this slit there continues posteriorly a semi-cylindrical crevice-like passage (fig. 9 G, *PrC*) between a ventrally convex dorsal plate, or *lamina dorsalis* (*lmd*), and a dorsally concave ventral plate, or *lamina ventralis* (*lmv*). The dorsal plate is the under wall of the labrum (*Lm*), the ventral plate is a continuation from

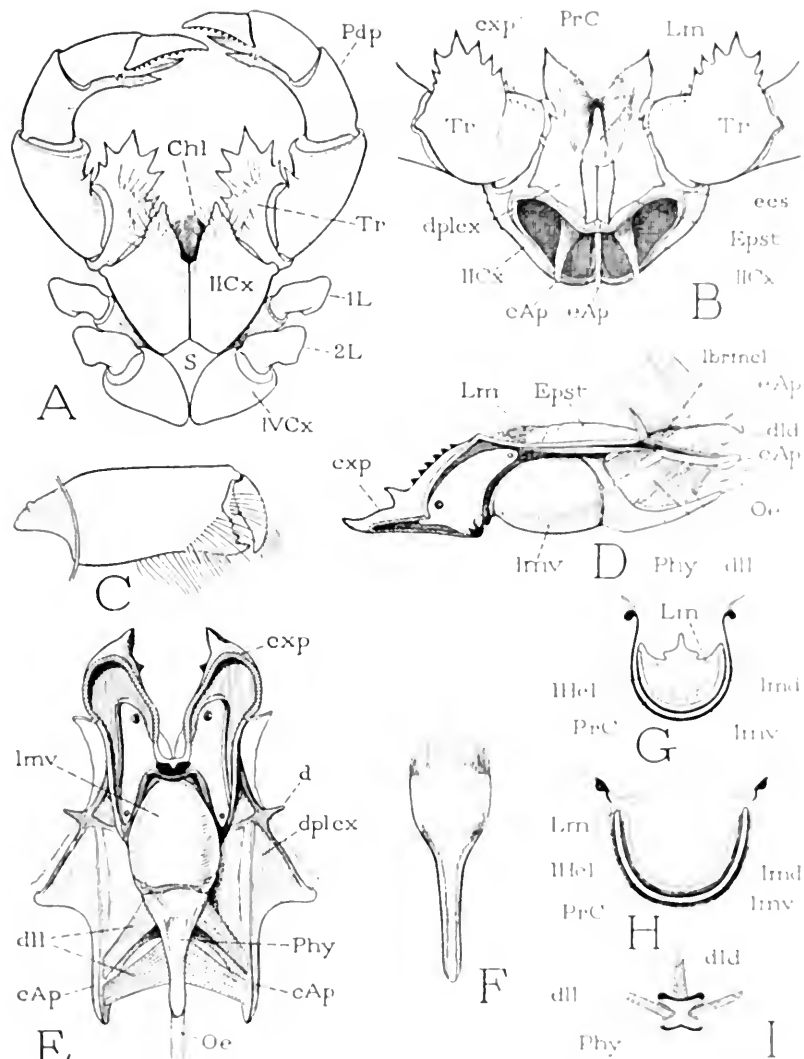


FIG. 9.—Pedipalpid-Uropygi-Thelyphonidae, *Mitrotopus* *mitos* (H. Lucas).

A, anterior part of body, with pedipalps and bases of first two pairs of legs ventral. B, mouth region, dorsal, as seen by removal of chelicerae. C, chelicera. D, lower wall of preoral cavity and pharynx, with muscles of labrum and pharynx, exposed by removal of left side of left pedipalp coxa. E, ventral walls of pedipalp coxae removed, exposing dorsal coxal walls, and ventral walls of preoral cavity and pharynx, with pharyngeal muscles. F, lamina dorsalis of preoral cavity and pharynx. G, cross section through anterior part of labrum and preoral cavity. H, section through middle of labrum and preoral cavity. I, section of pharynx.

the floor of the trough of the united coxae. The dorsal wall of the labrum (*Lm*) is a mass of spongy but dense tissue, so thick that it reduces the haemocoel of the labrum to a narrow slit (*lHcl*) concentric with the lumen of the food passage (*PrC*) below it. Pocock (1902) says the cavity of the labrum ("camarastome") "is filled for the most part with muscles which pass from its roof to its floor," but he evidently was mistaken as to the nature of the tissue in the labrum, and he must have missed the narrow haemocoel in its lower part. An anterior bundle of muscle fibers from the epistomal apodeme (*D*, *lbrmcl*), however, does attach to the posterior end of the thick dorsal wall of the labrum and merges into its spongy tissue. Behind the base of the labrum, the lamina dorsalis and the lamina ventralis are united along their upper edges (*H*), so that the food passage between them (*PrC*) becomes a closed cavity.

When this structure is seen from the side (fig. 9 D) or from below (*E*), the lamina ventralis of the food passage appears as a large, strongly convex, ovate body (*lmv*) firmly suspended from the median edges of the dorsal plates of the pedipalp coxae (*E*, *dplcx*). The wide posterior end of the lamina ventralis narrows into a long, free, tapering arm (*Phy*), which is the ventral wall of the sucking part of the ingestion apparatus, and is therefore the ventral plate of the pharynx. The lamina dorsalis (*F*) has a form similar to that of the lamina ventralis upon which it is closely superposed. Its anterior margin bears a fringe of long hairs guarding the slitlike opening of the food passage above mentioned; its posterior part tapers into the dorsal plate of the pharynx. The two plates of the pharyngeal region are connected by infolded lateral membranes (*I*) allowing of expansion and contraction. Dorsal dilator muscles of the pharynx (*D*, *I*, *dld*) arise on the epistomal apodeme (*D*, *eAp*); lateral dilators (*dll*) arise on the basal apodemes of the pedipalp coxae (*D*, *E*, *cAp*). Inasmuch as the pharyngeal plates of *Mastigoproctus* are directly continuous from the dorsal and ventral plates of the prepharyngeal food passage, the so-called pharynx is differentiated from the latter only by its expansible lumen and the possession of dilator muscles.

No functional explanation can readily be given for this curious ingestion apparatus of the Thelyphonidae. In a preserved specimen the dorsal and ventral plates of the prepharyngeal section are in close apposition, and there appears to be here no mechanism for expansion. Certainly nothing but liquid could be sucked through the passage, and the fringe of hairs at the entrance on the lamina dorsalis must effectively keep out food particles. The thelyphonids feed on insects and other terrestrial arthropods. They are said to seize and crush their

prey with the pedipalp chelae, and to further lacerate it with the chelicerae. The exuding juices, caught in the open trough of the pedipalp coxae, must be sucked in by the action of the pharynx. No evidence of extraoral digestion by these arachnids has been observed.

V. THE RICINULEI

The small and rare arachnids of this order include 12 known living species from Africa, Central America, and South America, and extinct Palaeozoic species from Europe and North America. The living forms, according to Ewing (1929), belong to two genera: one, *Ricinoides* Ewing (formerly *Cryptostemma*) is represented by six species in Africa, the other, *Cryptocellus* Westwood, includes six American species. The structure of the feeding organs of the Ricinulei is known only from the work of Hansen and Sørensen (1904), the scarcity of specimens in collections making them too valuable for anatomical purposes.

A distinctive feature of the Ricinulei is the presence of a large hoodlike lobe, the *cucullus*, movably hinged to the anterior margin of the carapace, which ordinarily (fig. 10 B, *Cuc*) conceals the chelicerae and the mouth region below it (A). The under surface of the cucullus bears a median ridge separating lateral concavities that fit over the chelicerae, which structure, as noted by Hansen and Sørensen (1904), suggests that the ricinuleid cucullus represents the anterior part of the carapace of the Thelyphonidae that overhangs and conceals the chelicerae. The chelicerae of the Ricinulei (D) are two-segmented as in the Pedipalpida. The small, chelate pedipalps (A, B, *Pdp*) have a ventral position, and their coxae are completely united to form a trough below the mouth. The pedipalp segmentation (E) is simple compared with that of the legs (B), there being two trochanteral segments (*1Tr*, *2Tr*) as in the legs, but the tibia is a long slender segment (*Tb*), and the tarsus (*Tar*) forms the small movable finger of the chela. In the legs (B) a patella intervenes between the femur and the short tibia, while the tarsus is divided into a long basal subsegment and five short distal subsegments.

The mouth region of the Ricinulei (fig. 10 C) resembles that of the Thelyphonidae (fig. 9 B) in that the floor of the preoral cavity (*PrC*) is formed by the united pedipalp coxae. In the ricinuleid, however, there are no free coxal processes since the coxae are here entirely united in a broad, troughlike under lip (fig. 10 C, *Hst*), which would appear to be quite comparable to the hypostome of Acarina (fig. 26 A, B, *Hst*). Projecting over the proximal part of the

coxal trough is the rounded labrum (*C, Lm*), which is supported on a large epistomal plate (*Epst*) united laterally with the dorsal walls of the adjoining parts of the pedipalp coxae. The epistome and the labrum together are regarded by Hansen and Sørensen as "pars basalis" and "pars apicalis" of the labrum, but these writers note the

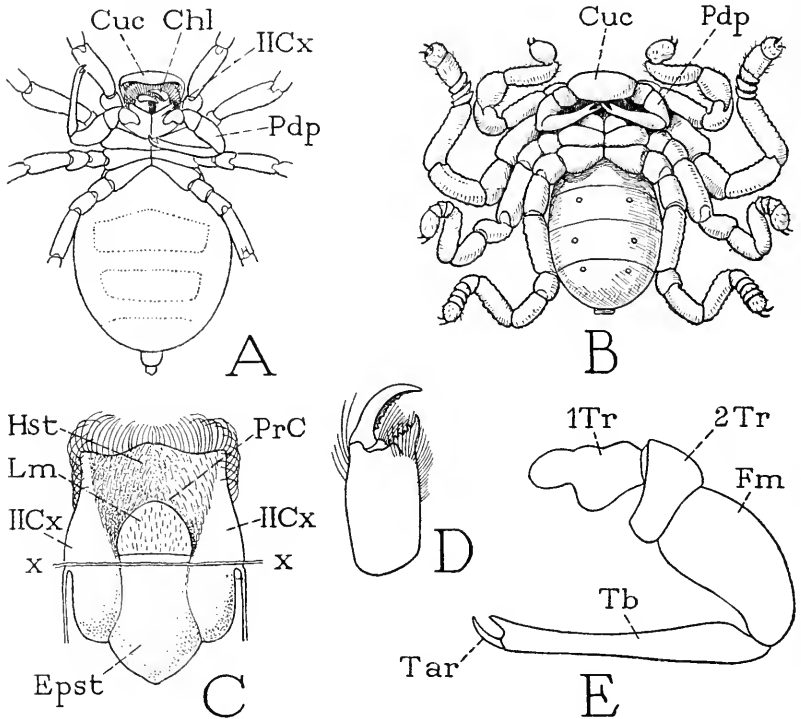


FIG. 10.—Ricinulei.

A, *Ricinoides crassipalpe* (H. & S.), ventral, with cucullus (*Cuc*) turned forward exposing the chelicerae (outline from Hansen and Sørensen, 1904). B, *R. westermanni* (Guérin), cucullus closed over labrum and chelicerae (from Karsch, 1893). C, *R. crassipalpe* (H. & S.), mouth region, dorsal, showing pedipalp coxae completely united in a broad under lip (*Hst*); *x-x*, line of invagination of basal parts of coxae and epistome (from Hansen and Sørensen, 1904). D, *R. karschii* (H. & S.), chelicera (from Hansen and Sørensen, 1904). E, *R. sjostedtii* (H. & S.), segmentation of the pedipalp (outline from Hansen and Sørensen, 1904).

distinctive features of the two parts, and that the "pars basalis" gives attachment to the dilator muscles of the sucking pump. The basal parts of the coxae and the greater part of the epistome are said to be invaginated into the body cavity proximal to the line *x-x* of the figure.

The internal part of the ingestion apparatus of the Ricinulei is not

fully or clearly described by Hansen and Sørensen from the single specimen at their disposal. A transverse "crest," concave dorsally, is said to be suspended from the united pedipalp coxae ("mandibles") and epistome, which is perforated by the oesophagus. From this we may suspect that there is here a structure resembling that in the Thelyphonidae. Muscles of the oesophagus and pharynx, according to Hansen and Sørensen, arise on the epistome ("pars basalis"), and also "muscles attached to the base of the pars apicalis." The last suggest the epistomal muscles inserted into the base of the labrum in *Mastigoproctus* (fig. 9 D, *lbrmcl*).

VI. THE CHELONETHIDA, OR PSEUDOSCORPIONIDA

The external anatomy of the pseudoscorpions, together with the respiratory system and the reproductive organs, has been described in great detail by Chamberlin (1931), and full accounts of the external and internal structure are given in the comprehensive works of Kästner (1927), Beier (1932), and Roewer (1936). The structure of the chelonethid feeding apparatus was correctly known to Croneberg (1888), and the external mouth parts are well portrayed by Pocock (1902). The information here given is taken mostly from these sources.

The conspicuous feature of the pseudoscorpions is the great relative size of the chelate pedipalps (fig. 11 A). The chelicerae (*Chl*) are small, two-segmented, and project straight forward from beneath the edge of the carapace. Below the chelicerae is a group of structures that constitute the mouth parts, including the labrum (*Lm*) above, a narrow under lip (*lpg*) below, and anterior processes of the pedipalp coxae (*IICx*) on the sides. The coxae of the pedipalps, as those of the legs, are almost contiguous along the midventral line of the body, being separated only by a narrow membranous space in which are no remnants of segmental sternal plates. The coxae themselves thus replace the sterna and become the actual ventral exoskeleton of the prosoma.

The chelonethid chelicerae (fig. 11 B, E) have an unusually elaborate structure, because, as Chamberlin (1931) points out, they are used for several specific purposes besides that of holding the prey during feeding. The pincers serve for carrying sand grains or other material used in nest-building, the movable finger gives exit to a silk-producing gland, and bears usually a spinneret near its apex; the chelicerae, furthermore, serve as cleaning organs, in adaptation to which function the fingers are equipped with membranous folds,

called *serrulae*, and finally they are the seat of important sense organs. The serrulae have different forms in different species (fig. 11 B, E, *Ser*), but characteristically the structures so called are thin folds or more or less free appendages either indented along the outer margin (C, *Ser*), or incised to form a comblike organ (E). The

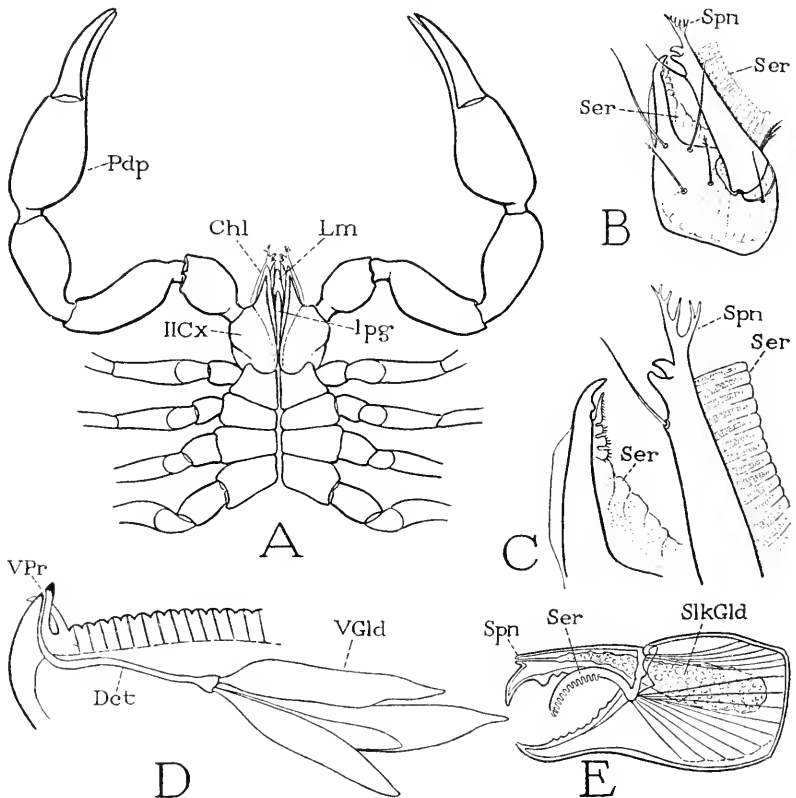


FIG. 11.—Chelonethida.

A, a pseudoscorpion (probably *Chelanops* sp.), female, prosoma and appendages, ventral. B, same, right chela, dorsal. C, same, details of cheliceral fingers, more enlarged. D, *Atemnus* sp., venom glands of pedipalp chela, with duct opening near apex of movable finger (from Chamberlin, 1931). E, *Chthonius* sp., chelicera, showing silk gland with duct opening through spinneret on movable finger (from Barrows, 1925).

cheliceral silk gland, shown contained within the chelicera at E of figure 11 (*SlkGld*), generally extends into the body cavity. There may be a single duct opening through a simple papilliform spinneret on the convex side of the movable finger (E, *Spn*), or there may be several ducts opening separately through the prongs of a branched

spinneret (B, C, *Spn*) known as the "galea." The spun silk is used for the making of cocoonlike nests in which the animal encloses itself for moulting, brood purposes, or for hibernation. The silk glands, therefore, are best developed in the immature stages and in the adult female; the glands of the adult male become reduced, and in some cases they appear to be absent.

The female pseudoscorpion deposits her eggs in a gelatinous brood sack attached around the genital aperture on the under side of the abdomen, and the young after hatching undergo their development here, fed on an albuminous substance discharged from the ovaries of the mother, until they are fully formed young pseudoscorpions. Some species carry the eggs and the young about with them in the open, but with most species the female encloses herself in a silken cocoon until the young are able to live independently. The remarkable metamorphosis that the young pseudoscorpion undergoes during its development is described by Barrois (1896), and an interesting account of the construction of the brood cocoon is given by Kew (1914).

The chela of the chelonethid pedipalp, as already shown (p. 14, fig. 5 G), has the same general structure as the chela of a scorpion (fig. 5 E, F) but it possesses the unique feature of containing in most species one or two glands supposed to secrete a venomous liquid. According to Chamberlin the glands may be present in both the movable and the fixed finger, in the movable finger only, or in the fixed finger only; in four families, however, they are absent. Each gland (fig. 11 D, *VGld*) consists of several elongate sacks with a common duct (*Dct*) opening through a pore (*UPr*) on a subapical, toothlike process on the convex side of the finger containing the gland.

The coxae of the pedipalps are free from each other, and are connected only at their bases with the narrow membranous ventral wall of the body between them (fig. 12 B, *HCx*). Anteriorly the coxae are produced into a pair of thick processes (*cxp*), normally embracing the labrum (figs. 11 A, 12 A). Though these coxal extensions are called "manducatory" processes, they have no chewing function, and serve merely to form the lateral walls of the preoral food chamber. A flat dorsal appendage arising from the base of each lobe in most species, and a thin ventral flange (fig. 12 A, *ls, li*) are known respectively as the *lamina superior* and the *lamina inferior*.

The labrum projects between the coxal processes of the pedipalps as a free lobe of varying width in different species (fig. 12 A, B, *lm*). The dorsal surface of the labrum is continued proximally into an epistomal plate (A, *Epst*), which is mostly invaginated into the anterior body wall below the bases of the chelicerae, and thus becomes prac-

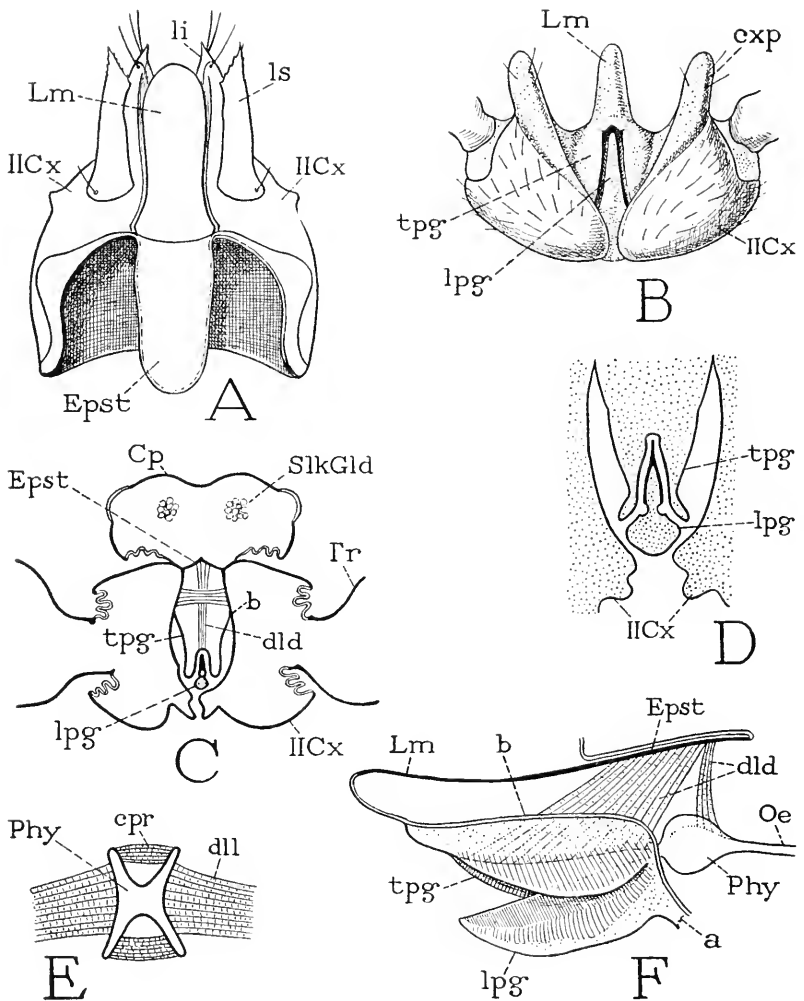


FIG. 12.—Chelonethida.

A, *Apochthonius intermedius* Chamb., mouth parts, dorsal; *li*, *ls*, appendicular lobes of pedipalp coxae (from Chamberlin, 1931). B, *Garypus* sp., mouth parts, ventral, pedipalp coxae spread apart showing lophognath (*lpg*) in groove of taphrognath (*tpg*) (from Pocock, 1902). C, *Garypus sini* Chamb., cross section through anterior part of carapace and bases of pedipalps, showing relation of lophognath (*lpg*) to taphrognath (*tpg*) (from Chamberlin, 1931). D, same, section of taphrognath and lophognath more enlarged. E, same, cross section of pharynx (from Chamberlin, 1931). F, diagram of chelonethid ingestion apparatus based on Croneberg (1888) and Chamberlin (1931); *a*, connection of lophognath with pedipalp coxa, *b*, cut edge along *b* in C.

tically an apodemal structure. The chelonethid epistome is termed by Chamberlin the "intermaxillary jugum" because its distal part is united with the pedipalp coxae, which are commonly called "maxillae"; but on its under surface are attached the usual dorsal muscles of the ingestion apparatus (F), showing that the plate in question is that here termed the epistome in other arachnids. The epistome is similarly invaginated or overgrown in the Ricinulei and some Acarina, and in the last order is known as the "subchelicerel plate."

The under surface of the labrum is continued posteriorly as the dorsal wall of the preoral food passage, and is produced into an elongate lobe (fig. 12 B, *tpg*) enclosed between the mesal surfaces of the pedipalp coxae (which latter, as shown at B, are spread apart). The under surface of the lobe is deeply channeled lengthwise, and receives the narrow under lip (*lpg*), which carries a high, crestlike ridge on its upper surface, as seen in cross section at D. Chamberlin (1931) likens these two structures to a pair of jaws lying one above the other. The upper grooved "jaw" he terms the *taphrognath*, the lower crested "jaw" the *lophognath*.

The so-called lophognath, or under lip, is a laterally compressed, tapering, median lobe projecting forward from the venter of the prosoma between the bases of the pedipalp coxae (fig. 12 B, *lpg*), and would thus appear to be a sternal structure, as said by Pocock (1902). Chamberlin shows that the lophognath is attached by two basal arms to the pedipalp coxae, but its form and structure do not suggest that the lophognath itself is of coxal origin.

The relation of the taphrognath and the lophognath to each other is shown diagrammatically at F of figure 12, in which the lophognath (*lpg*) is partly exposed by being pulled down from the groove of the taphrognath (*tpg*). The opposing surfaces of the taphrognath and the lophognath are shown by Chamberlin to be corrugated by numerous fine, closely set, transverse ridges, fringed with minute spines directed inward. The exposed lateral surfaces of the two lobes are also ridged, but on these areas the ridges are somewhat farther apart. On the crest of the taphrognath are inserted the fibers of a large flat muscle (C, F, *dld*) having its origin on the under surface of the invaginated epistome (*Epst*).

At their inner ends the taphrognath and the lophognath are united by a union of the lips of the former with the sides of the latter (fig. 12 F). There is thus formed here the true oral aperture, which opens immediately into a relatively small, pear-shaped pharyngeal sack (*Phy*). This organ shows in cross section (E) the usual structure of the arachnid pharynx: the concave dorsal, ventral, and lateral walls

give a four-rayed figure. Constrictor muscles attached on the points of the folds are shown by Croneberg (1888) to surround the pharynx; lateral constrictor muscles are said to be present by Chamberlin (1931), though they are not shown in his figure (E). Lateral dilator muscles (*dll*) inserted on the side walls of the pharynx have their origins on the lateral walls of the pedipalp coxae. Chamberlin makes no mention of dorsal dilators, but Croneberg specifically says that a group of fibers from the epistome ("basal part of the rostrum") goes to the pharynx, as is shown in the diagram at F. The distribution of most of the epistomal muscles on the preoral under surface of the labrum is an unusual condition found only in the Chelonethida, but it can be correlated with that in the Solpugida, in which a few of the anterior fibers extend into the labrum (fig. 7 G), and is suggestive of that in *Mastigoproctus* in which a large bundle of epistomal fibers goes to the posterior end of the labrum (fig. 9 D, *lbrmcl*).

The chelonethid ingestion apparatus has no duplicate among other arachnids, and no other even approaches it in structure. The taphrognath might be likened to the lamina dorsalis of the food passage in Thelyphonidae, but the lophognath is not comparable to the lamina ventralis, and the sacklike chelonethid pharynx is quite distinct from the preoral part of the feeding apparatus. The principal sucking organ of the chelonethids would appear to be the preoral structure formed of the taphrognath and the lophognath, rather than the relatively small pharynx. A lifting of the taphrognath from the lophognath by a contraction of its dorsal muscles (fig. 12 F) would draw the liquid food into the taphrognathic channel, where, by a reversal of the action, it would be impelled back to the mouth to be sucked into the pharynx. The food-conducting channel from the prey, however, as Chamberlin notes, must be formed by the approximated laminae of the pedipalp coxae and the distal part of the labrum (A).

The Chelonethida are said to catch and kill their victims with the pedipalp chelae, from which the prey is given to the chelicerae to be held while feeding. Chamberlin (1931), in describing the feeding of *Chelifer fuscipes* Banks on a small lepidopterous larva, says the active caterpillar, grasped and tightly held in the chela, becomes motionless in 30 seconds, and is then drawn up to the mouth parts and seized by the chelicerae. In a few minutes the larva becomes much shrunken, when a new hold is taken by the chelicerae and feeding resumed at another point of attack. Schlottke (1933b), observing the feeding of *Chelifer cancroides* L. on meal worms, notes that the sucking of the larval juices is preceded by an inflation of the larva with a secretion from the mouth of the chelonethid, which evidently liquefies the

tissues of the prey. During feeding the soft-skinned larva thus alternately expands and contracts according to whether it is being injected with the solvent liquid or exhausted by suction. Though *Chelifera* is classed by Chamberlin as a genus having a venom gland in each finger of the chelae, Schlottke says no poisonous effect was to be observed on the captured prey.

VII. THE SCORPIONIDA

With the scorpions more parts of the animal's anatomy have been brought into the service of the feeding function than in any other arachnid. There is present the usual association of the chelicerae, the labrum, and the pedipalp coxae, but the under lip of the scorpion is composed of endite lobes from the coxae of both the first and the second pairs of legs, the pedipalps bear strong chelae, and, in addition to these structures, the postabdominal tail with its sting plays an important role in the feeding process by the subduing of prey caught and held in the pedipalp chelae.

The relatively small, three-segmented chelicerae of the scorpion project straight forward from beneath the overhanging edge of the carapace (fig. 13 A). They are turned on their sides so that the movable finger of each appendage has a lateral position. In *Centruroides* this finger is deeply cleft into two points (B, C), which clasp the immovable finger when the pincer is closed. The pedipalp chelae of the scorpion have been sufficiently described in the General Discussion (p. 14, fig. 5 D, E, F), in which the identity of the segments composing the chela was deduced from a comparison with the structure and musculature of the legs: the "hand" of the chela is the tibia, the movable finger is the tarsus, with possibly the tip derived from the pretarsus.

Conspicuous at the anterior end of the scorpion's body is a large, open, quadrate cavity (fig. 13 D, *PrC*) between the flat mesal surfaces of the pedipalp coxae (*IICx*), covered above by the flattened chelicerae (*Chl*), and closed below by the closely appressed endite lobes of the coxae of the first and second legs (*IIIEndt*, *IIEndt*). This cavity is evidently a receiving chamber for food material crushed by the pedipalp chelae and further comminuted by the chelicerae. Concealed within it is the labrum, and below the latter the mouth, both being fully exposed on removal of the chelicerae and the pedipalps (E). The labrum (*Lm*) is a large, soft, laterally compressed lobe with a rounded dorsal wall terminating in a fringe of long hairs (*G*, *Lm*), below which the anterior labral wall recedes to the short ventral

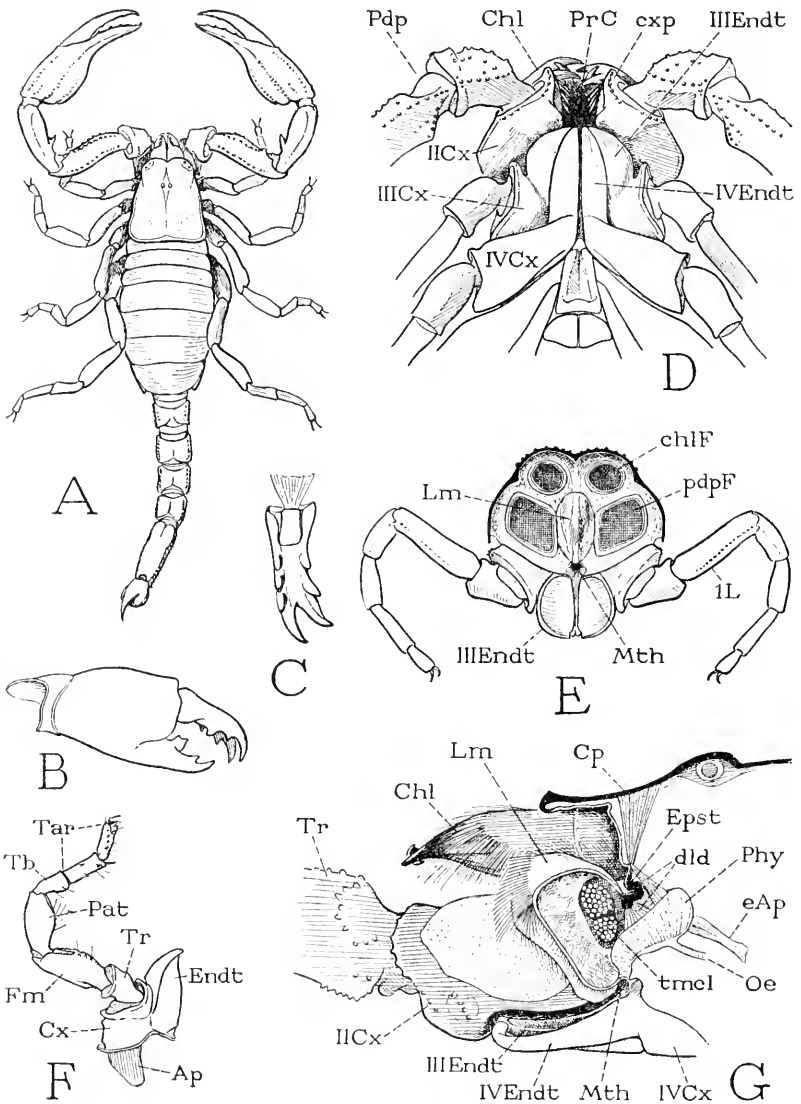


FIG. 13.—Scorpionida.

A, *Chactas vanbenedeni* Gervais, female. B, *Centruroides* sp., chelicera. C, same, movable finger of chelicera, mesal surface. D, same, anterior part of body, ventral, showing mouth parts and large preoral food cavity (PrC). E, same, anterior end of body with chelicerae and pedipalps removed, exposing the mouth (Mth) at base of coxal endites forming a basinlike under lip. F, *Pandinus* sp., right first leg, ventral, showing large coxal endite. G, *Centruroides* sp., longitudinal section through anterior end of body and labrum, with right chelicera and base of right pedipalp in place.

surface overhanging the mouth and the inner end of the preoral food cavity. The mouth (E, G, *Mth*) is a small unguarded aperture beneath the base of the labrum. From below the mouth there projects forward the broad, basinlike floor of the preoral cavity (E) formed of the endite lobes of the first leg coxae (*IIIEndt*). Between the mesal edges of these coxal lobes is a groove, which is closed below by the closely applied endites of the second leg coxae (D, *IVEndt*), and proximally runs into the mouth (E, *Mth*). The pedipalp coxae are entirely separated from each other, and there is no recognizable remnant of the pedipalp sternum in the scorpion. The broad, flat, mesal surfaces of the coxae are mostly membranous (G, *IICx*), and form the lateral walls of the preoral food cavity (D, *PrC*). Anteriorly the coxae are produced into short coxal processes (*cxp*) mesad of the trochanters. The coxal bases are connected by two thick bundles of transverse muscle fibers, which pass through the labrum (G, *tmcl*). These muscles occur in other arachnids, and are labral muscles; in the scorpion they appear to be operative on the pedipalp coxae by reason of a union of the base of the labrum with the coxal walls.

The lobes of the first and second leg coxae (fig. 13 D, *IIIEndt*, *IVEndt*) that form the lower lip of the scorpion, or floor of the preoral cavity, are here termed *endites* because they arise from the bases of the coxae (F) and not from their distal ends as do the coxal processes (*cxp*) of the pedipalp coxae. Coxal lobes of the same nature occur also in the Phalangida.

There is no prominent epistomal plate in the scorpion, but at the base of the dorsal wall of the labrum is a strong, irregular sclerotization (fig. 13 G, *Epst*), which clearly represents the epistome, since on it are attached the dorsal dilators of the pharynx (*dld*), and from it is given off a pair of apodemal arms (*cAp*).

The pharynx of the scorpion is a small, pear-shaped sack enlarging upward and posteriorly from its narrowed entrance at the mouth (fig. 13 G, *Phy*). It is somewhat compressed laterally, rounded at the inner end; the slender oesophagus (*Oe*) departs from the lower wall at the end of a ventral channel from the mouth. The dorsal wall of the sack is deeply infolded and the trough of the invagination is strengthened by an elastic rod. Dilator muscles attached on the concave dorsal wall (*dld*) arise on the epistomal sclerotization (*Epst*) at the base of the labrum, and lateral dilators take their origins on the epistomal apodemes (*cAp*). Compressor muscles cover the lateral walls of the pharynx.

The sting of the scorpion appears to be an appendage of the last

abdominal segment (fig. 14 B), and not the terminal segment itself. The end segment, or telson, of an arthropod contains the anus; in the scorpion the anus lies before the base of the sting in the end of the sting-supporting segment (A, *An*). The scorpion sting in its relation to the end of the abdomen is comparable with the flagellum of the Thelyphonidae and the tail spine of *Limulus*. The base of the sting is articulated on the end of the supporting segment in such a manner that its principal movement is in a vertical plane, but because

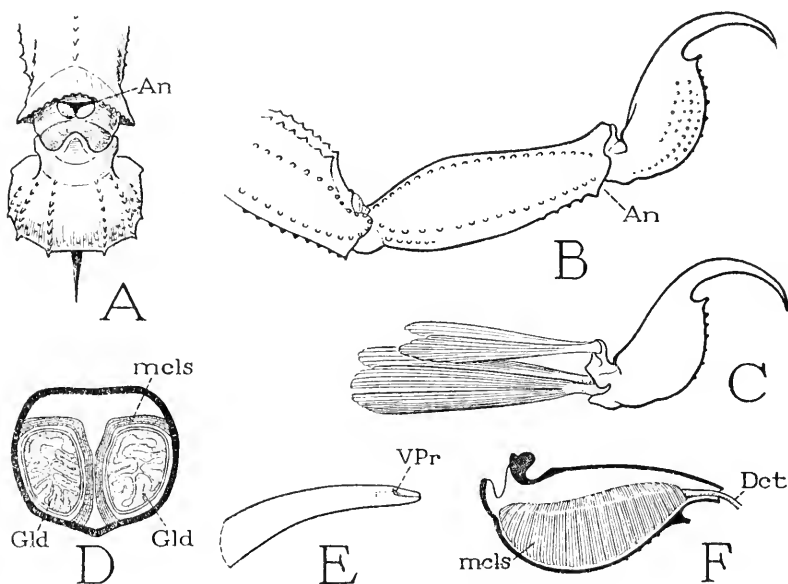


FIG. 14.—The sting of a scorpion.

A, *Pandinus* sp., end of last postabdominal segment, with the sting, ventral, showing the anus (*An*) in last segment at base of sting. B, *Centruroides* sp., last two postabdominal segments and the sting, lateral. C, same, the sting with its muscles arising in the last segment. D, same, cross section through base of sting, showing the venom glands and enclosing muscles. E, same, terminal part of sting, showing aperture of left venom duct. F, same, right half of base of sting, mesal view, showing muscles covering right gland, and duct.

of the amplitude of the articular membrane it is capable also of lateral movements. On its base are attached four long muscles, two dorsal, and one on each side (C). The dorsal muscles are widely divergent but both are inserted on a strong dorsal process of the sting base. The lateral muscles are attached below the articular points of the sting, and are hence depressors, but probably, acting as antagonists, they produce also lateral movements of the sting; each lateral muscle separates into two distinct bundles of fibers. The segments of

the postabdomen are likewise strongly muscled, each being provided with a single wide dorsal muscle with an axial tendon, a lateral muscle on each side, and in addition a large median ventral muscle.

The venom of the scorpion is produced in two sacklike glands contained within the swollen basal part of the sting (fig. 14 D, *Gld*). The glands have individual ducts opening separately near the point of the sting through two lateral pores (E, *l'Pr*), from which grooves extend to the tip. Each gland is closely invested along the entire length of its mesal and dorsal surfaces by a thick muscular sheath made up of several layers of semicircular fibers (D, F, *mcls*), attached dorsally on the upper part of the lateral wall of the containing capsule, and ventrally on the lower wall. Contraction of the muscles evidently compresses the gland sacks against the rigid capsular walls.

The scorpion is certainly not a primitive arachnid, though an ancient one. *If*, therefore, the scorpions have any relationship to the extinct Eurypterida, the theory of Versluys and Demoll (1920), insofar as it derives the eurypterids from primitive scorpions, would appear to be more reasonable than the reverse. That the Xiphosurida have a scorpion ancestry, however, is difficult to believe, considering their primitive method of feeding and their evident relation to the trilobites.

VIII. THE PHALANGIDA, OR OPILIONES

The Phalangida are characterized by the presence of lobes arising from the *bases* of the coxae of the pedipalps and the first two pairs of legs. Because of their position on the coxal bases these lobes of the phalangiids are analogous to the lobes on the second and third leg coxae of the scorpions, which, as explained in the last section, are here termed *endites* to distinguish them from the distal processes of the pedipalp coxae in other arachnids. The pedipalp endites of the Phalangida are always closely associated with the mouth, and have the appearance of a pair of jaws; they may be prehensile, but they have no masticatory function, and hence are not appropriately termed "manducatory" lobes. The first leg endites in the Phalangiidae resemble the pedipalp endites and are likewise associated with the mouth, but the endites of the second legs never have a direct relation to feeding. In the Cyphophthalmi and the Laniatores the coxal endites, whether hard or soft in texture, are immovably fixed on the coxae, but in the Palpatores they are flexibly attached to the coxae, and become independently movable because some of the body muscles of the coxae are attached on their bases. A labrum is always present,

supported on an epistomal plate between the pedipalp coxae. An under lip, when present, is formed by the projecting sternum of the first-leg segment.

The mouth parts of the Cyphophthalmi, of which a general comparative account is given by Hansen and Sørensen (1904), are of more simple structure than those of the other two suborders of the Phalangida. The following description of the parts in *Holosiro acaroides* Ewing is made from specimens furnished by Dr. I. M. Newell of the University of Oregon.

The chelicerae of *Holosiro* (fig. 15 C) are relatively long, and are three-segmented, with the movable finger of the chela articulated laterally on the second segment. The pedipalp telopodites (I, *Pdp*) are slender, smaller than the legs, but the coxae (*IICx*) are large, and each bears a large endite (*IIEndt*) projecting ventrally and mesally. On removing the appendage, the endite is seen to be a solid extension from the inner face of the coxa (A, B, *Endt*) ending with a soft ventral lobe. The convex outer surface of the lobe (A) is clothed with small setae, the flat or slightly concave inner surface (B) is finely and closely striated. The two apposed pedipalp endites present ventrally rounded padlike surfaces (I, *IIEndt*) separated by a narrow cleft that leads up to the mouth. Though coxal muscles of the pedipalps are attached on the endites, the latter are so firmly fixed on the coxae that they have no independent movement.

The mouth of the Cyphophthalmids is entirely concealed beneath the bases of the chelicerae and between the pedipalp endites. Above the mouth is a U-shaped epistomal plate (fig. 15 D, *Epst*) supporting the labrum (*Lm*). In the specimens of *Holosiro* examined, the labrum was broken in dissection, but Hansen and Sørensen (1904) describe the organ in other cyphophthalmids as a thin, laterally compressed plate projecting downward and forward from the "clypeus" between the pedipalp coxae. The "clypeus" of these writers is the epistome.

The ventral surface of the prosoma of *Holosiro* (fig. 15 I) is occupied entirely by the large coxal segments of the legs, the long axes of which radiate on each side from a point in front of the genital opening. The coxae of the first legs (*IIICx*) are thus turned forward so that they embrace the pedipalp coxae (*IICx*). Each first-leg coxa is traversed anteroposteriorly across its middle by a strong ridge (*crr*) that runs out in a small point on the anterior coxal margin, and forms the lower edge of a broad, slightly concave surface on the inner side of the coxa (E, F, I), which bears at its mesal end a soft, rounded, lobular endite (*Endt*) with a small, hairy papilla behind the pedipalp endite. Between the two opposed mesal surfaces of the first-leg coxae

is a widely open space, the so-called *stomotheca*, in which are contained the endites of the pedipalps and the first legs (1). Posteriorly the stomotheca is closed by the approximated inner ends of the second-leg coxae (*IVCx*), on which are rounded elevations of an endite

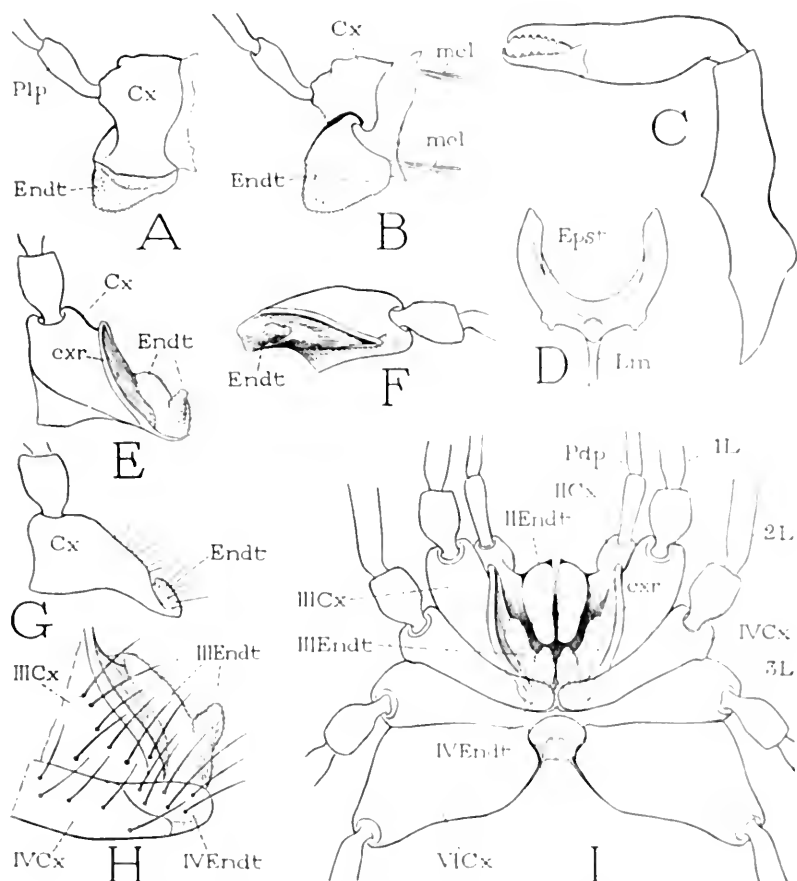


FIG. 15.—Phalangida-Cyphophthalmi, *Holoisiro acaroides* Ewing.

A, base of left pedipalp, lateral. B, base of right pedipalp, mesal. C, left chelicera, lateral. D, epistome and part of labrum, dorsal. E, base of right first leg, ventral. F, same, mesal. G, base of right second leg, posterior. H, details of mesal ends of coxae of right first and second legs more enlarged, ventral. I, bases of prosomatic appendages, except chelicerae, showing mouth parts, ventral. (All figures except H same enlargement)

nature (*IVEndt*) that somewhat overlap the inner ends of the first-leg coxae. When the coxae of the second legs are detached and viewed from behind (G) the endites are seen to be distinct lobes, though their surfaces are hard and not membranous.

Since there are no sternal plates on the prosoma of the Cyphophthalmi, there is no under-lip structure closing the stomotheca below, such as the sternum of the first-leg segment in Phalangiidae. When the chelicerae are deflexed, however, their chelae are turned posteriorly, upside down, close against the endites of the pedipalps and the first legs; in this position the pincers fit neatly between the ridges of the first-leg coxae, and completely cover the stomotheca from below. During feeding, therefore, prey held in the chelicerae could thus be applied directly to the cleft between the pedipalp endites, through which the exuding juices might be drawn up to the mouth.

The suborder Palpatores, or Plagiostethi, includes the familiar long-legged phalangiids of the family Phalangiidae. The first full description of one of these arachnids goes back to Tulk (1843), who gives a detailed account of the external and internal structure of *Phalangium opilio* L. Tulk cites earlier writers but says their work is either superficial or lacking in detail. Among more recent papers those by Police (1927), and by Kästner (1933a) on the feeding organs of *Opilio* and *Phalangium* are the most important. Since Police critically reviews the work of others before his time, and gives numerous quotations from their descriptions, the student historically interested is referred to his paper. The following account of the phalangiid mouth parts as developed in the family Phalangiidae is based on a species of *Leiobunum*.

A front view of the body of a phalangiid (fig. 16 B) presents a most unusual appearance for an arachnid because of the number of structures that are associated with the mouth, but which entirely conceal it. Uppermost is the slender, tapering labrum (*Lm*) projecting as a free lobe from an epistomal plate (*Epst*) between the pedipalp coxae (*IIC.r*). Immediately below the labrum and converging beneath it are the large, soft, endites of the pedipalp coxae (*IIEndt*), each with a pair of accessory lobules on its base; and beneath these endites are the thick, padlike endites of the first pair of legs (*IIIEndt*). Below all these structures, projecting like a broad under lip, is the sternal plate of the first leg segment (*IIIS*), which forms the floor of the preoral cavity. Finally, projecting beneath the sternum are seen the small, hairy endites of the second-leg coxae (*IVEndt*).

The chelicerae of *Leiobunum*, as in all the Phalangida, are three-segmented (fig. 16 A, *Chl*). The basal segments extend forward from the anterior body wall above the epistome, the distal segments with the relatively small pincers hang downward at the sides of the labrum. The base of each chelicera is produced into the body as a large apodemal extension from the lateral and ventral walls of the proximal

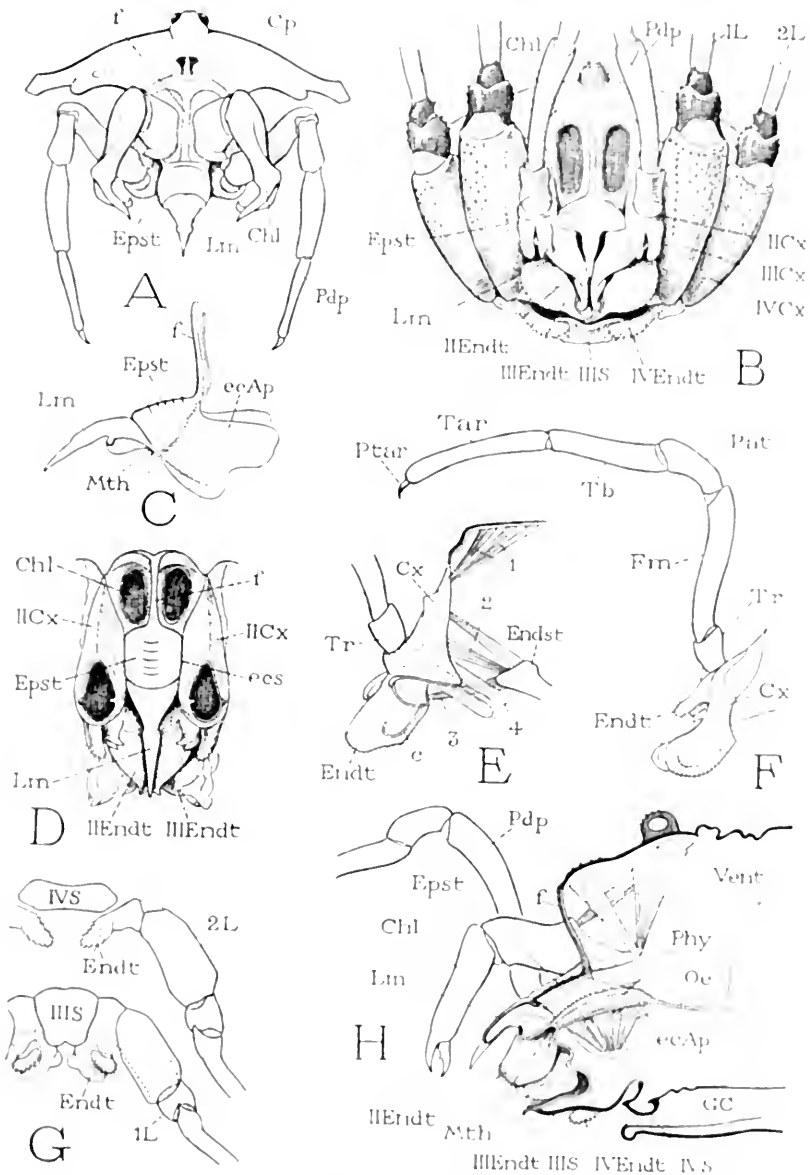


FIG. 10.—*Phalangula-Palpatores, Leucanium* sp.

A, anterior end of body with chelicerae and pedipalps. B, anterior end of body, chelicerae removed, turned dorsally to show mouth parts. C, labrum and epistome, with epistomocoxal apodemes, left side. D, mouth parts, anterodorsal view, chelicerae and telopodites of pedipalps removed. E, base of right pedipalp, with coxal endite and muscles, mesal view; *c*, "pseudotracheal" canal. F, left pedipalp, lateral. G, bases of first and second legs, with coxal endites and corresponding sterna. H, longitudinal section of anterior end of body, showing mouth parts of right side, mouth, and pharynx with its muscles.

segment, on which are inserted levator and depressor muscles arising on the carapace laterad of the eyes (H). Between the cheliceral bases a strong sclerotic bar (A, *f*) in the anterior body wall connects the epistome with the anterior edge of the carapace.

The pedipalp coxae are elongate dorsoventrally (fig. 16 D, *IICx*), as are the coxae of the legs (B). They are implanted in the membranous anterior wall of the body laterad of the chelicerae, and their upper ends, which reach almost to the level of the dorsal edges of the cheliceral bases (B, *Chl*), are weakly articulated on the anterior margin of the carapace. Mesally the dorsal walls of the pedipalp coxae are united with the lateral margins of the epistome (*Epst*), and along the line of union on each side (*ecs*) is inflected a broad, platelike epistomo-coxal apodeme (figs. 16 C, 17 C, *ecAp*). There is no median epistomal apodeme in *Leiobunum*. The musculature of the pedipalp coxa is the same as that of a leg in that it comprises dorsal muscles arising on the carapace (fig. 16 E, *1*), and ventral muscles (*2*, *3*) arising on the corresponding anterior arm of the endosternum (*Endst*). Each group of muscles includes mesal and lateral fibers representing the promoters and remoters of a leg. One of the ventral muscles of the pedipalp (*3*), being inserted on the base of the coxal endite, gives this flexible lobe an independent movement. The long muscles of the pedipalp trochanter (*4*) take their origins on the coxal lamella of the epistomo-coxal apodeme.

The endites of the pedipalps are broad, soft lobes, each with a pair of small lobules projecting anteriorly from its base (fig. 16 B, F). The flat mesal surfaces of these endites (E) are in apposition before the mouth (B, *IIEndt*). Each contains in its posterior part a slender, curved, deeply sunken groove (E, *c*) that runs up into the mouth. The groove is known as a "pseudotrachea" because of its finely ribbed walls, which give it the appearance of a trachea open along the outer side. The endites of the first legs (G, *1L*) are thick, soft, padlike lobes (B, H, *IIIEndt*) lying below the level of the mouth (H, *Mth*). Ventrally they come together under the pedipalp lobes where their extended margins overlap to form a gutterlike channel leading back toward the pharyngeal entrance (B). The small endites of the second legs (G, *2L*) project beneath the pedipalp sternum (B, H, *IVEndt*), and are too far removed from the mouth to have any direct relation to feeding, but they probably have a sensory function. According to Police (1927) each of the four endites associated with the mouth contains a pyriform, sacklike gland, the glands of the pedipalps opening on the dorsal margins of the mesal surfaces of the endites,

those of the first legs opening centrally on the inner surfaces. The nature of the secretion of these glands is not determined.

The mouth entrance of *Phalangium opilio* L. is described by Kästner (1933a, 1935) as a short funnel with its walls thrown outward in six radiating folds. The same region is termed the "buccal atrium" by Police (1927), who shows its structure in two cross sections (fig. 17 A, B). Both writers find that this region is provided with dorsal (anterior) muscles (A, *dld*) arising within the labrum, and ventral (posterior) muscles (*dlv*) arising on the epistomo-coxal apodemes. Police notes that the mouth atrium, therefore, can be dilated only in a vertical plane. Kästner says the mouth can be closed by the first circular muscles of the pharynx immediately behind it, and he regards the strong transverse muscle in the base of the labrum

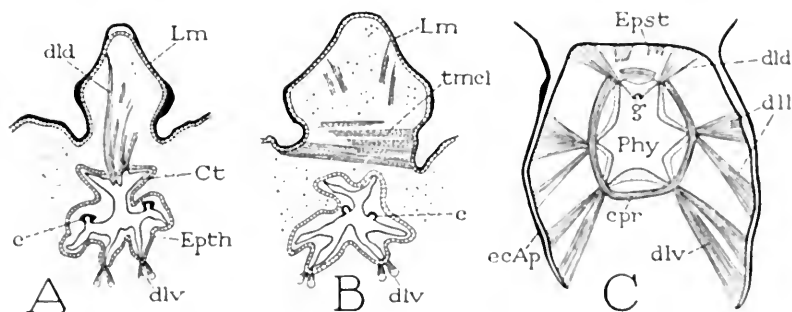


FIG. 17.—Phalangida-Phalangüidae, *Phalangium opilio* (Latr.).

A, cross section of labrum and mouth region, showing "pseudotracheal" canals (*c*) in walls of the latter (from Police, 1927). B, section through same parts farther back, showing transverse muscles of labrum (from Police, 1927). C, cross section through epistome, epistomocoxal apodemes (*ecAp*), and pharynx, showing groove (*g*) in dorsal wall of pharynx (from Kästner, 1933a).

(B, *trncl*) as being also a closer of the mouth funnel, though, as Police points out, it would appear that this last muscle merely compresses the labrum. The six folds of the mouth, two dorsal, two lateral, and two ventral, are continued into similar folds of the walls of the pharynx (C, *Phy*). The pseudotracheal canals of the pedipalp endites (fig. 16 E, *c*) open into the lumina of the lateral mouth folds (fig. 17 A, B, *c*).

The pharynx of *Phalangium opilio* is said by Kästner to rise vertically from the mouth and then to turn abruptly backward in a narrowed horizontal part; in Police's figure of the same species the distinction between the two parts is much less accentuated. The pharynx of *Leiobunum* (fig. 16 H, *Phy*) is only slightly curved upward; it runs posteriorly between the large epistomo-coxal apodemes

(*ecAp*) parallel to the epistome (*Epst*), and is continued into the narrow oesophagus (*Oe*). On the crest of each of the six radial folds of the pharyngeal wall is inserted a row of dilator muscles (fig. 17 C). The dorsal muscles (*dld*) have their origins on the epistome (*Epst*); the lateral and ventral muscles (*dll*, *dlv*) arise on the epistomal lamellae of the epistomo-coxal apodemes (*ecAp*). Circular compressor fibers (*cpr*) alternating with the dilator muscles surround the entire length of the pharynx.

The dorsal wall of the pharynx of *Phalangium opilio* is shown by Kästner to be traversed by a narrow median groove with sclerotic walls (fig. 17 C, *g*). By contraction of the mouth region, Kästner says, the anterior end of the pharyngeal groove is brought into contact with the inner ends of the pseudotracheal canals of the pedipalp endites. The canal system, therefore, evidently has some unified function, though what this function may be is not known. It is of interest to note that a dorsal pharyngeal canal is present also in the Araneida (fig. 19 C, *dc*).

The oesophagus is a narrow tube (fig. 16 H, *Oe*) going direct from the end of the pharynx to the ventriculus (*Vent*). Just before joining the stomach the oesophagus is slightly enlarged, but apparently does not form here a sucking apparatus. According to Kästner the oesophagus lacks dilator muscles, and the circular muscles end where the tube enters the nerve mass.

In their feeding habits the phalangiids appear to be exceptional among the Arachnida in that they ingest fragments of their food as well as liquid. Hansen and Sørensen (1904) say that "the middle and anal divisions of the alimentary canal may be quite filled with more or less digested portions of food, fragments of animals which are easily recognized by the broken pieces of chitine which are contained in them; but such are never found in the diverticula." These writers did not mention any particular species. Police (1927) says that sections of *Phalangium opilio* show in the stomach only soft material, though this may contain fragments of viscera and tracheae. Tulk (1843) gives a rather fanciful description of the working of the mouth parts during feeding, in which the oral endites are conceived to be jaws for crushing the prey and extracting the juices, while a further crushing function is attributed to the pharynx. The pharynx, however, has no internal armature such as Tulk describes, and the oral endites, though independently movable on the supporting coxae, are too soft in texture to be masticatory organs. Though pieces of the internal organs of the prey may be taken into the stomach by the phalangiids, such fragments, according to Frank (1938), are dissolved

in the stomach, and the final digestive processes take place intracellularly within the stomach diverticula as with other arachnids.

Kästner (1925), in describing the observed manner of feeding by *Platybunus corniger* Herm. on a spider, says the captured prey is held in the chelicerae, and the abdomen first torn open. Then, while one of the pincers holds the cut edge, the other reaches into the opening and pulls out pieces of the entrails and brings them to the mouth parts. The fragments are seized by the coxal endites of the pedipalps and first legs, which open and close alternately and pass the food on to the mouth. After the meal, Kästner observes, both the chelicerae and the pedipalps, which latter have assisted in the act of feeding, are cleaned by drawing them through the oral lobes.

IX. THE ARANEIDA

The spiders possess several features in the feeding apparatus by which they differ from the other arachnids. The two-segmented chelicerae have usually no process opposing the fanglike terminal segment, which closes against the basal segment. In all families except the Uloboridae the chelicerae contain poison glands. The pedipalp coxae, except in Liphistiidae and most of the Mygalomorphae, have large distal processes usually forming strong but immovable jawlike lobes. The lower lip, or floor of the preoral food cavity, is formed by the sternum of the pedipalp segment, which may be either free between the pedipalp coxae, or united with the sternal plate of the legs. The dorsal and ventral walls of the pharynx are more or less sclerotized, forming a strong dorsal plate and a more weakly developed ventral plate, the two connected laterally by membranes. The dorsal plate is traversed by a median channel running forward from the orifice of the oesophagus. The proventriculus is a strongly developed pumping organ, the so-called "stomach pump," and may be of more importance in the sucking function than the pharynx itself.

The cheliceral poison gland is a sacklike organ (figs. 19 A, 20 F) with a duct traversing the fang to open on the convex side of the latter near the point (fig. 19 A, *I'Pr*). In the Mygalomorphae the gland is contained entirely or mostly within the basal segment of the chelicera; in other groups it may project into the body cavity as far as the prosomatic nerve mass or beyond it. The gland is covered by a layer of muscle fibers; the fibers are said by Millot (1931) to be generally arranged spirally along the length of the sack, but to present variations and irregularities. In *Latrodectus mactans*, the highly venomous "black widow" spider, the muscles, as shown by Reese (1944), run longitudinally on the gland (fig. 20 F).

Glands contained in the pedipalp coxae and opening into the preoral food cavity are said to be present in all members of the Araneida; they are known as the *salivary glands*, or "maxillary" glands. According to Petrunkevitch (1933) these glands are unicellular in *Hypochilus*, but in all other genera they are multicellular sacklike organs, the number in each coxa varying with the species. In *Liphistius* and the Mygalomorphae the glands, as shown by Bertkau (1885) in *Atypus*, are distributed along the entire length of the coxa, and open irregularly on the upper surface near the inner edge. In other spiders the glands open on a small oval or circular area on the inner face of each coxa, known as the "sieve plate" because of its perforation by the duct orifices. A gland, or pair of glands, is present also in the labrum. The structure of the labral gland in *Atypus piceus* Sultzter is described in detail by Bertkau (1885), who says the gland opens on the outer surface of the labrum. According to Petrunkevitch (1933) there is apparently a pair of labral glands ("rostral glands") in all spiders, but in some they are so closely united as to appear to be a single organ. The two ducts discharge into a wide, slitlike atrium that opens to the exterior.

In the feeding of the spiders, extraoral digestion plays an important part. A powerful digestive fluid from the stomach is discharged on the prey and completely liquefies the soft tissues. So copious and effective is this exuded digestive fluid that some spiders are able to consume even small vertebrates, which they kill by the venomous bite of the chelicerae. In recording observations of the feeding of *Palystes natalius* (Karsch), a South African member of the Heteropodidae, on a small lizard, Warren (1923) says: "All the ordinary tissues, including tendons and cartilages, were rapidly softened, and the body became plastic, while the bones were completely disarticulated. The voluntary muscles and all the softer tissues dissolved with great rapidity when the out-flowing and in-flowing currents of digestive fluid gained access to them. After a period of about two and a half hours the body (about $1\frac{3}{4}$ in. long) of the lizard had been reduced to a small, blackish, rounded and somewhat dry mass about $\frac{1}{4}$ in. in diameter. This mass the spider allowed to drop to the ground." Abraham (1923) records the feeding of a species of *Thalassius*, family Pisauridae, on live fish, small frogs, and tadpoles. He describes the catching of fish in an aquarium by the spider, which holds to a rock by its long hind legs and plunges into the water to seize its victim. Baerg (1938) says of a large species of *Dugesia* (*Dugesia* Aviculariidae) that in captivity it will feed on recently killed animals, "accepting

besides various large insects, also crayfish, small lizards, small snakes, and even small fish."

A detailed account of observations on the feeding act of spiders is given by Kästner (see Gerhardt and Kästner, 1937, pp. 447-449). Some species, particularly those that feed on hard-shelled insects, such as beetles, merely suck out the dissolved tissues through a wound in the prey. Others, including most spiders, thrust the cheliceral claws into the body of the prey and tear the entrails to give the injected digestive fluid better access to the tissues; finally they crush and knead the prey in order to get the last juice from the mangled body. The digestive fluid is said by Kästner to be expelled repeatedly as a large drop of clear liquid that fills the preoral cavity of the spider and flows into the wound of the prey, and is then sucked back. The mechanical treatment of the prey, according to Kästner, is done entirely with the chelicerae, not with the jawlike lobes of the pedipalp coxae. The latter serve merely as the lateral walls of the space between the labrum above and the pedipalp sternum below, which is the food conduit from the prey to the mouth. During feeding, Kästner observes, a rapid extension and contraction of the labrum within the food conduit evidently exerts a preoral sucking action on the food liquid. The hard, insoluble parts of the prey, prevented from entering the mouth by the bristles of the coxae and sternum, accumulate in a mass on the lower lip and are finally dislodged by the pedipalps.

Earlier writers assumed the source of the exuded digestive liquid to be the glands of the pedipalp coxae, or so-called "maxillary" glands, but others have contended that the liquid is too copious to be produced in these relatively small glands, and must come from the stomach. Bertkau (1885) demonstrated experimentally that the secretion of the pedipalp glands does have a solvent effect on the muscles of a fly, but only after 24 hours was the muscle tissue reduced to a pulp, while a live spider dissolves the tissues of a fly often in a few hours. Kästner (see Gerhardt and Kästner, 1937, pp. 448-450) has shown from observation on a transparent *Theridium* species that during feeding there takes place a heaving and fluctuating movement of the alimentary mass in the abdomen, and that when a drop of fluid is discharged from the mouth the small end branches of the stomach diverticula contract and expand, suggesting that by this action the digestive juice is being expelled. From quantitative analyses of the digestive enzymes of *Arvicularia*, Schlottke (1936) demonstrated that no proteinase of sufficient strength to accomplish extraoral digestion is produced in any part of the spider anterior to the stomach. The stomach diverticula, according to Schlottke's results, secrete a strong

trypsinlike proteinase, an aminopolypeptidase, a carboxypolypeptidase, and a dipeptidase of varying strength. Lipase is strongly present, and amylase in some cases, but probably a part of the amylase comes from the prey. Since the several ferments are not found in the same amount in all individuals, it is evident that the diverticula do not secrete a uniform digestive liquid.

The Mygalomorphae (Orthognatha) differ from the other spiders, with respect to the feeding organs, in that the basal segments of the chelicerae are directed straight forward from the body, and that the pedipalp coxae, except in Atypidae, have only small, inconspicuous anterior processes instead of the large jawlike lobes present in most other spiders. As an example of the mouth-part structure in this group a species of *Eurypelma*, one of the "tarantulas" so called in America, is here described.

The pedipalps of *Eurypelma hentzi* Chamb. are smaller than the legs; in the female each appendage has six normal segments (fig. 18 C) and a small, clawlike pretarsus (D, *Ptar*). The single elongate tarsal segment is padded on the ventral surface with a thick, velvety coating of small soft hairs (G, *Tar*), which distally form two apical lobelike tufts. The pretarsal claw arises from a padlike surface on the end of the tarsus (D), but is ordinarily almost concealed by the overhanging hairs, only its tip being visible in the notch between the apical tufts (G, *Ptar*). The claw is provided with the usual two pretarsal muscles, a levator, arising in the tarsus, and a depressor, arising in the tibia and patella with its fibers inserted on a long ventral tendon of the claw. In the male, the pedipalp ends with a sperm-carrying organ (fig. 18 E, *Ptar*), which clearly is a modified and specialized pretarsal segment, since, as Barrows (1925) has shown, two muscles are attached on its base, a levator (*lvptar*) arising in the tarsus, and a depressor (*dpptar*) in the tibia. The legs differ from the pedipalps in having two subsegments in the tarsus, and a pair of pretarsal claws.

The pedipalp coxae lie horizontally in the plane of the leg coxae, but they diverge anteriorly from the suboral sternum between their bases. Their mesal faces adjoin the epistome, but are connected with the latter only by membranous conjunctivae. In *Eurypelma* and most of the other Mygalomorphae the pedipalp coxae have small anterior processes at the inner sides of the trochanteral bases (fig. 18 C, F, *cxp*), but in Atypidae (H) these coxal processes are large, thick lobes (*cxp*) projecting beneath the chelicerae.

The huge chelicerae of *Eurypelma* (fig. 18 A, *Chl*) project forward but sag somewhat downward from the receding anterior wall of the body, which seems scarce able to support them. The fangs turn back-

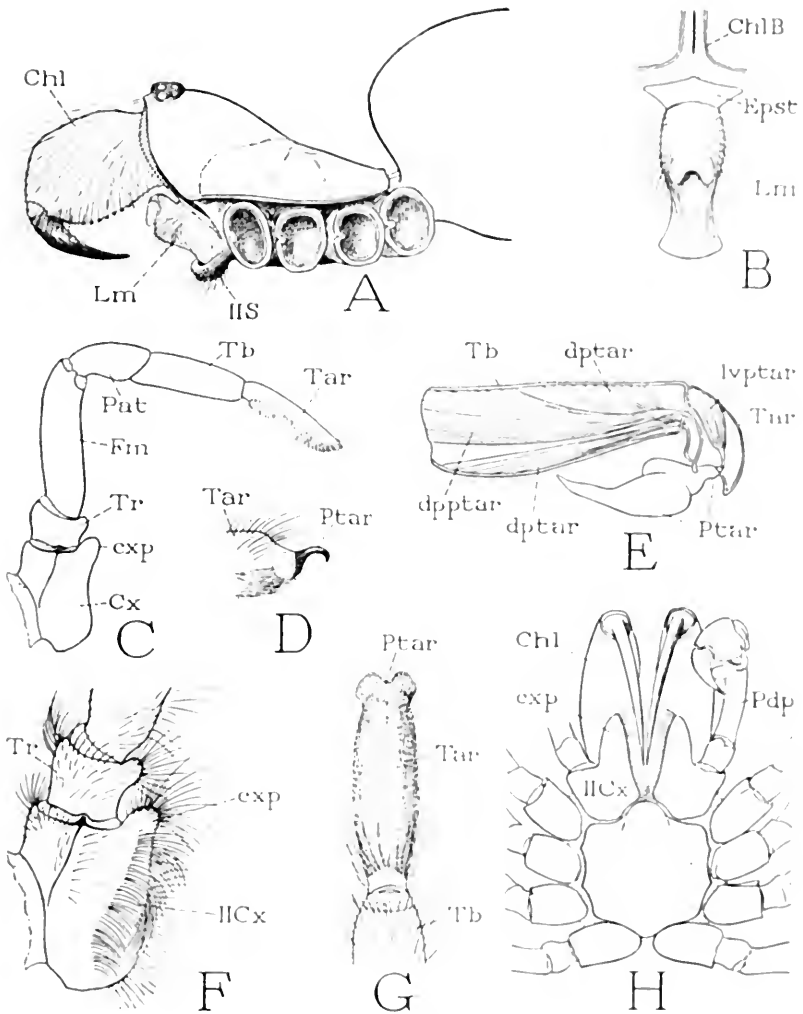


FIG. 18. Araneida Mygalomorpha.

A, *Eurypelma hentzi* Chamb., female, prosoma, with pedipalps and legs removed. B, same, epistome and labrum, anterior. C, same, left pedipalp, mesal. D, same, pretarsal claw of pedipalp exposed on end of partly denuded tarsus. E, *Eurypelma californica* Ausser, male, tarsus and pretarsus of pedipalp, with muscles (from Barrows, 1925). F, *Eurypelma hentzi* Chamb., female, basal part of left pedipalp. G, same, terminal segments of pedipalp, ventral. H, *Atypus bicolor* Lucas, prosoma and bases of appendages, ventral, showing large coxal processes of pedipalp coxae.

ward below the large basal segments. The venom gland of each appendage is an elongate, cylindrical sack (fig. 19 A) lying in the upper part of the basal segment. It is covered by a layer of flat, strongly striated muscle fibers, which go obliquely upward and posteriorly on each side, and their ends overlap along the midventral and middorsal lines. The duct traverses the fang to open by a pore (*VPr*) near the tip on the convex surface.

Beneath the chelicerae, the labrum (fig. 18 A, *Lm*) projects from the anterior wall of the prosoma in the form of a large, soft lobe with two small lobules on the angle between its short dorsal surface and the long, receding anterior surface. The sides are compressed (B) but expanded below to form before the mouth an upper lip fitting snugly into the concavity of the under-lip sternum (A, *IIS*). From the base of the dorsal surface of the labrum there is reflected upward in the body wall beneath the chelicerae a small, transverse epistomal plate (B, *Epst*) with prolonged lateral angles. The sternum of the pedipalp segment (A, *IIS*), which, as in all the Araneida, constitutes the under wall of the preoral cavity, is a small plate detached from the large sternal plate of the leg segments. As just noted, its concave upper surface receives the expanded lower end of the labrum.

Between the under surface of the labrum and the pedipalp sternum is the short preoral food cavity (fig. 19 B, *PrC*), which leads directly through the mouth (*Mth*) into the lumen of the pharynx (*Phy*). The pharynx slopes steeply upward behind the labrum and epistome, and the oesophagus (*Oe*) dips downward from its inner end. The walls of the pharynx are formed of an inwardly convex dorsal plate (*dpl*) and a concave ventral plate (*vpl*) united along their edges by membranous conjunctivae. The strongly sclerotic dorsal plate (C) is continued from the under surface of the labrum (*Lm*), the larger but weaker ventral plate (E) from the upper surface of the deutosternum (*IIS*). The dorsal plate (C) presents a high, rounded median lobe, flanked by two narrow lateral lobes. The middle lobe is deeply incised at its inner end, but a median arm is continued through the emargination. Traversing the middle lobe from the end of the arm almost to the labrum is a median channel (C, D, *dc*) with strongly sclerotic walls. At its upper (posterior) end the channel is widely open before the mouth of the oesophagus, but along the arm of the plate it is nearly closed by lateral folds of membrane, and then becomes again an open groove that tapers to a narrow slit ending shortly behind the labrum. On the dorsal plate of the pharynx is

attached a large dilator muscle (B), the fibers of which spread from their origins on the epistome (*Epst*).

The relatively weak, concave ventral plate of the pharynx (fig. 19 E) is longer than the dorsal plate because the edge of the pedipalp sternum (*IIS*) extends beyond the labrum. The median part of this plate, or ventral wall of the pharynx, is but weakly sclerotized except for a strong bar, deeply forked at the upper end, that traverses its middle. On the inner end of the ventral plate is inserted a pair of large muscles from the prosomatic carapace (B).

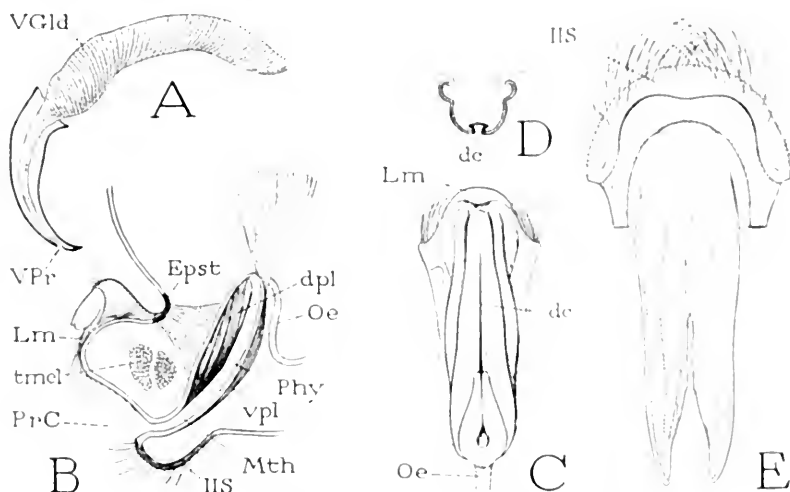


FIG. 19.—Araneida-Mygalomorphae, *Eurypelma hentzi* Chamb.

A, cheliceral fang and venom gland. B, longitudinal section through mouth region and pharynx. C, dorsal plate of pharynx and lower end of labrum, ventral. D, cross section of dorsal plate of pharynx. E, ventral plate of pharynx and distal end of pedipalp sternum, dorsal.

The mouth parts of the Dipneumonomorphae (Labidognatha), or ordinary spiders, differ from those of the Mygalomorphae principally in that the chelicerae hang downward from the anterior edge of the prosoma (fig. 20 B), and that the pedipalp coxae have large lobes at the sides of the mouth which give the appearance of a pair of strong jaws (C, D, *crp*). These coxal lobes of the spiders have no independent movement, since they are solidly affixed to the coxae. In appearance they suggest the coxal endites of the Phalangida, but inasmuch as they arise from the distal ends of the coxae, and in some forms, as in *Dysdera crocata* C. Koch (G), they are no different from the large coxal processes of the mygalomorph *Atypus* (fig. 18 H), it is clear that they are merely special developments of the

usual anterior coxal processes, such as those typical of the Mygalomorphae (fig. 18 C, F, *cxp*).

The labrum of the dipneumone spiders is a supraoral lobe of

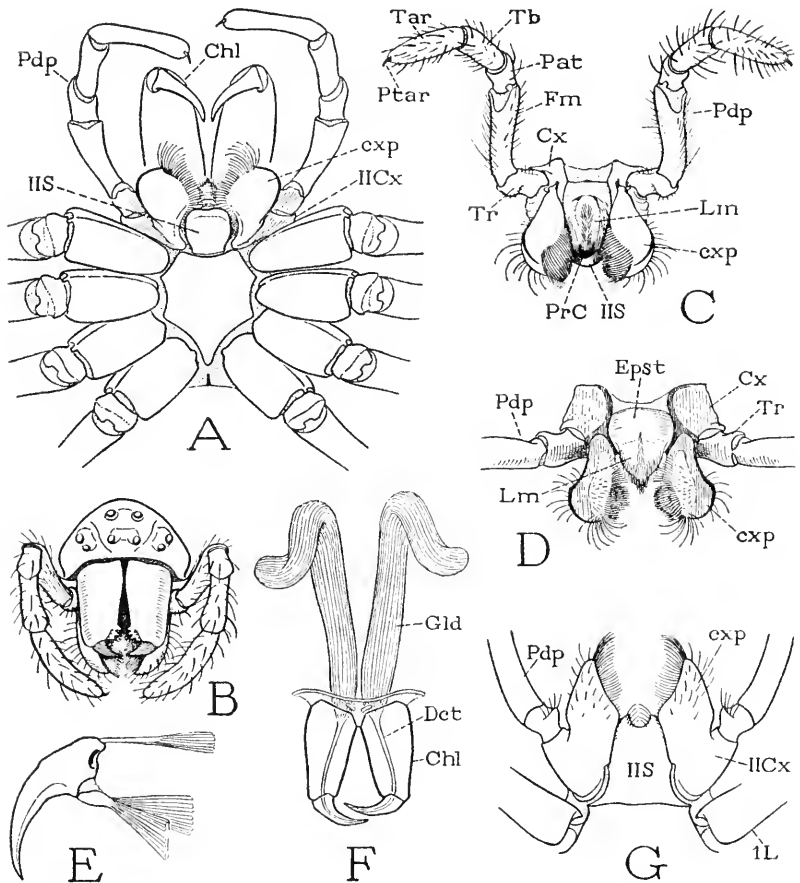


FIG. 20.—Araneida-Dipneumonomorphae.

A, *Heteropoda venatoria* L., Sparassidae, prosoma, with chelicerae, pedipalps, and bases of legs, ventral. B, *Metargiope trifasciata* (Forsk.), Argiopidae, female, anterior end of body. C, same, mouth region and pedipalps, anterior, showing preoral cavity (*PrC*), coxal processes of pedipalps, and pedipalp sternum. D, *Heteropoda venatoria* L., epistome, labrum, and bases of pedipalps, anterior. E, *Metargiope trifasciata* (Forsk.), cheliceral fang and muscles. F, *Latrodectus mactans* Fab., Theridiidae, female, chelicerae with poison glands and ducts. G, *Dysdera crocata* C. Koch, female, Dysderidae, anterior part of ventral surface of body, with bases of pedipalps and first legs, showing large coxal processes embracing the suboral pedipalp sternum.

variable form and size (fig. 20 C, D; fig. 21 B, *Lm*) suspended from the epistome (fig. 20 D, *Epst*), which is united laterally with the pedipalp coxae (*Cx*). Between the labrum and the under lip formed

of the pedipalp sternum is a short preoral cavity (fig. 20 C; fig. 21 B, *PrC*) closed laterally by the lobes of the pedipalp coxae. The mouth at the inner end of the preoral cavity opens directly into the pharynx.

The pharynx rises steeply from the mouth behind the labrum and epistome (fig. 21 A, *Phy*). In a cross section of the pharynx of

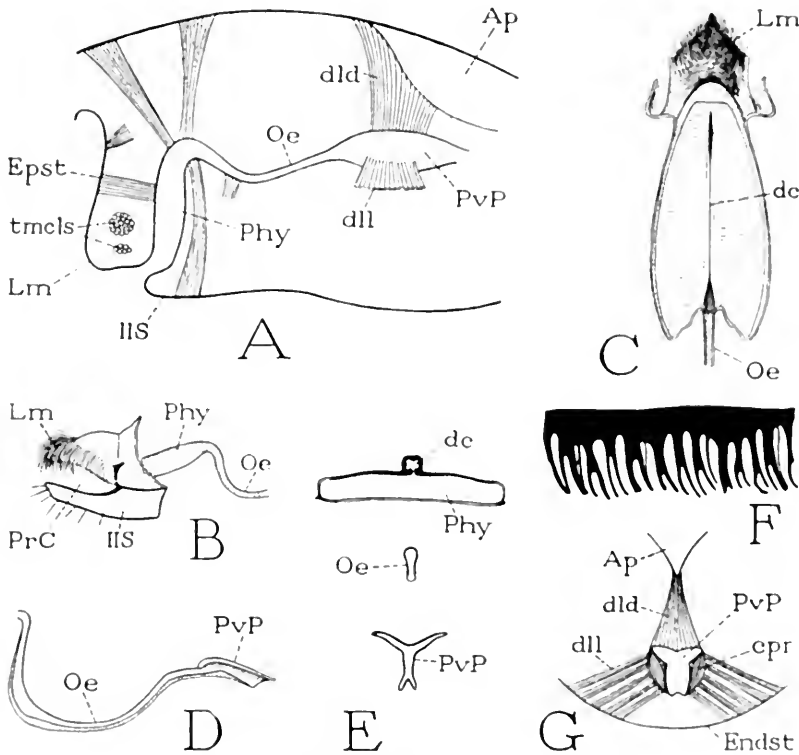


FIG. 21.—Aracnida-Dipneumonomorphae.

A, *Agelena naevia* Walck., diagrammatic longitudinal section of the prosoma, showing muscles of the stomodaeum (from Brown, 1939). B, *Dysdera crocata* C. Koch, labrum, pedipalp sternum, and pharynx, left side. C, *Heteropoda venatoria* L., labrum and dorsal plate of pharynx, ventral. D, same, oesophagus and proventricular pump, muscles removed. E, same, cross sections of pharynx, oesophagus, and proventricular pump. F, *Tegenaria domestica* (Cl.), longitudinal section of piece of dorsal plate of pharynx, showing transverse ridges, greatly magnified (from Bartels, 1930). G, *Agelena naevia* Walck., cross section of proventricular pump, with muscles (from Brown, 1939).

Heteropoda venatoria (E, *Phy*), the organ is seen to be much flattened dorsoventrally. In its dorsal (anterior) wall is a well-developed plate (C) traversed by a median channel (*dc*); the opposite wall is weak except for a sclerotized band along each lateral margin, which is connected by membrane with the dorsal plate. The channel of the

dorsal plate is widely open at its inner end before the oesophageal aperture (C), but beyond this point the lips are in such close apposition that the channel becomes practically a closed tube (E, *dc*), except that it opens again where it approaches the mouth (C). On each side of the median channel the surface of the plate is crossed by numerous fine ridges.

A longitudinal section of the dorsal pharyngeal plate of *Tegenaria domestica* (Cl.) (fig. 21 F), as given by Bartels (1930), shows that the surface ridges are high, thin folds of the cuticle, most of them forked along their free edges, between which are deep grooves. The grooves, Bartels believed, open mesally into the dorsal channel, though he was not able to demonstrate the apertures. In experiments on spiders allowed to drink water containing a suspension of India ink or carmine particles, he found the granules massed in the grooves and along the edges of the median channel, but very few in the channel itself, while only some of the smallest particles had gone into the stomach with the water. From these experiments Bartels concluded that the ridges of the pharyngeal plate constitute a filtering apparatus for the retention of undissolved material in the predigested food, while the liquid part enters the oesophagus by way of the grooves and the dorsal channel of the pharynx. The main lumen of the pharynx, according to Bartels, serves for the discharge of the digestive juices that first liquefy the soft tissues of the prey. However, inasmuch as with other arachnids the food is ingested through the pharynx lumen, it might be supposed that the dorsal channel of the Araneida serves as the conduit for the exuded digestive liquid; the very fact that the grooves of the dorsal plate become so readily clogged would seem to disqualify them as food conduits. A dorsal channel of the pharynx is present, however, also in the Phalangiidae, which are not known to practice extraoral digestion.

The musculature of the araneid pharynx includes the usual dilators arising on the epistome (fig. 21 A), and muscles attached on its upper end. It is shown by Brown (1939) that in *Agelena naevia* (A) there are two pairs of long dorsal muscles from the carapace, and a pair of ventral muscles from the pedipalp sternum, all attached on the upper end of the pharynx. The first dorsal muscle Brown calls a dilator of the pharynx, the second a retractor; the ventral muscle he terms a retractor of the "labium." Within the labrum are two transverse muscles (*tmcls*) as in most other arachnids.

The oesophagus curves downward and again upward from the pharynx (fig. 21 A, B, D), and expands to form a proventricular pump (A, D, *PvP*) before reaching the stomach. The oesophagus

of *Heteropoda venatoria* is laterally compressed (fig. 21 E, *Oe*); its dorsal wall is sclerotized and its ventral wall membranous (D). The proventriculus is Y-shaped in section (E, *PcP*), with the membranous lower wall of the stem inflected. A section of the proventricular pump of *Agelena naccia* (G), as figured by Brown (1939), shows strong sets of dilator muscles arising dorsally (*dld*) on an apodeme (*Ap*) of the carapace, and lateroventrally (*dll*) on the endosternum (*Endst*); compressor muscles (*cpr*) unite the dorsal and ventral folds of the proventricular wall.

X. THE ACARINA

The distinctive feature relating to the feeding apparatus of the Acarina is the presence of a discrete head structure carrying the mouth parts, known as the *capitulum*, *capitellum*, or *gnathosoma*. The first term is adopted here as being more generally used than the others. The capitulum projects in front of the part of the animal that bears the eyes, when eyes are present, and hence does not include the entire head region derived from the cephalic lobe of the embryo (fig. 1 E, *HL*). The acarine capitulum is simply a special development of the part of the cephalon that lies before the carapace in other arachnids, together with the chelicerae and the pedipalp coxae. The capitulum is more or less retracted into a recession of the body behind it, within which it is attached by a flexible conjunctiva that allows of retraction and protraction. The socketlike cavity that receives the base of the capitulum is commonly called the "camerostome," but the etymological significance of the term in this connection is not clear.

The essential thing that differentiates the capitulum of the Acarina (fig. 22 A) from the head of a spider or other arachnid (fig. 2 A) is the sclerotization of the cephalic wall above the bases of the chelicerae to form a dorsal fold or plate (fig. 22 A, *Tect*) projecting from beneath the anterior edge of the dorsum of the body (D). This plate, termed "rostrum" and "epistome," may more appropriately be named the *tectum* (*tectum capituli*), since it forms the dorsal wall, or "roof," of the capitulum. Laterally the tectum is fused with the dorsally extended basal angles of the pedipalp coxae (*IICx*), which are united with each other ventrally, so that there is thus formed a continuously sclerotized ring, the *basis capituli*. The coxae bear the palps (*Plp*), and their dorsal surfaces, as in other arachnids, are united mesally with a subcheliceral epistomal plate (*Epst*), which bears the labrum (*Lm*) overhanging the mouth. The ventral wall of the capitulum is produced beneath the mouth and the labrum as a

median lobe (*Hst*) known as the *hypostome*. The hypostome appears to be formed by the union of anterior coxal processes, and is thus quite comparable to the similarly formed under lip of the Ricinulei (fig. 10 C). The hypostome is the floor of the preoral cavity, and

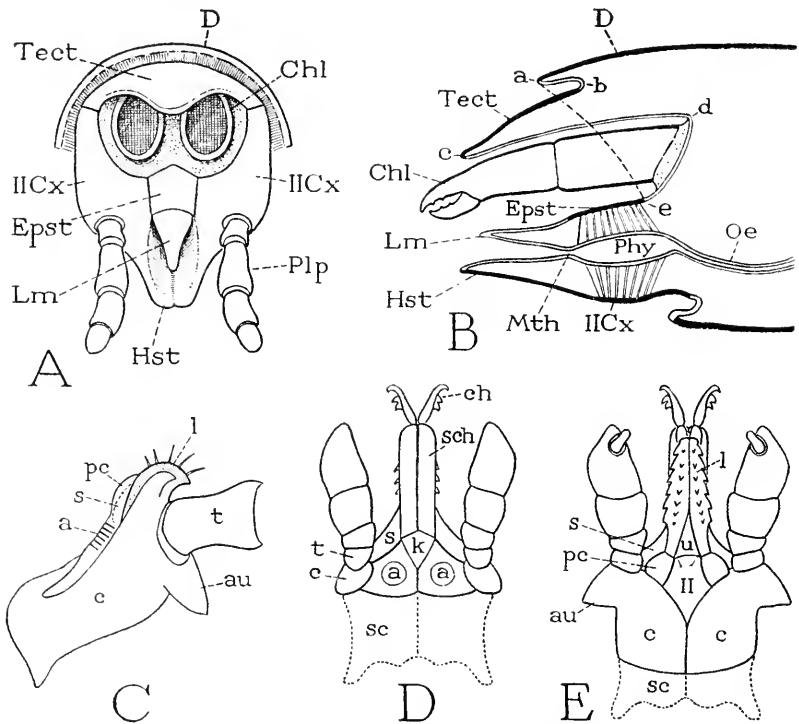


FIG. 22.—Acarina, structure of the capitulum.

A, diagrammatic anterior view of the capitulum, with chelicerae cut off at bases, showing lower lip, or hypostome (*Hst*), formed of united coxal processes (compare with A of figure 2). B, diagrammatic longitudinal section of anterior end of body (compare with D of figure 2). C, diagram of a primitive ixodid coxa according to Schulze (1935), showing parts that may enter into the formation of the capitulum: *a*, area porosa; *au*, auricle; *c*, coxa; *l*, coxal process; *pc*, processus cymatii; *s*, sella; *t*, trochanter. D, E, composition of the capitulum, dorsal and ventral, according to Schulze (1935): *ch*, chelicera; *II*, sternum; *k*, part of primary cephalic lobe; *sc*, subcoxa; *sch*, cheliceral sheath; *u*, hypopharynx; other lettering as on C.

its concave or grooved upper surface, more or less covered by the labrum, is the preoral food canal of the Acarina.

A lengthwise sectional view of the acarine capitulum (fig. 22 B) shows the tectum (*Tect*) as the outer wall of a fold (*b-c-d*) extended over the chelicerae, which latter thus appear to be sunken into a pouch of the head wall above the epistome. By comparison with a corre-

sponding section of any other arachnid it will be seen that the anterior cephalic wall in the Acarina, instead of going direct from the edge of the carapace to the base of the epistome, as in the spider (fig. 2 D, *a-e*), makes a complex folding (fig. 22 B, *a-b-c-d-e*) between the same two points. The mouth (*Mth*) between the base of the labrum and the base of the hypostome leads directly into the pharynx (*Phy*), which, as in other arachnids (fig. 2 D), has dorsal dilator muscles arising on the epistome (*Epst*).

To this simple basic structure of the capitulum there are added in the different groups of Acarina various secondary modifications, which may include the following: (1) a retraction of the capitulum into the anterior end of the body; (2) elongation, invagination, or other modifications of the chelicerae; (3) formation of membranous cheliceral sheaths; (4) invagination of the epistome; (5) reduction of the labrum; (6) elongation of the hypostome; (7) development of appendicular lobes on the pedipalp coxae associated with the hypostome; (8) reduction of the palps.

The exact composition of the acarine capitulum is perhaps more complex than that indicated above. However, Wagner (1894), in describing the embryonic development of *Ixodes calcaratus* Bir., ascribes the major part of the capitulum to the pedipalp coxae. The coxae, he says, are at first simple, but later a lobe grows out from each; then the coxae take a longitudinal position and their basal parts gradually grow upward around the bases of the chelicerae to form the capitular walls, while the lobes unite in an unpaired under-lip process (the hypostome). Reuter (1909) is more complete in his account of the development of the capitulum in *Pediculopsis graminum* (Reut.). The rudiments of the chelicerae and pedipalps, he says, undergo very great changes in the transformations by which these appendages, together with the cephalic lobe, are converted into the gnathosoma. The chelicerae undergo a considerable reduction and are transposed to a preoral position. The pedipalps are also reduced in their distal parts, but their basal parts embrace the chelicerae laterally, while ventrally they unite medially with each other, thus forming the lateral and ventral walls of the gnathosoma. The upper wall of this headlike structure, however, is derived from an unpaired projecting anterior part of the cephalic lobe, which unites laterally with the dorsal parts of the pedipalp coxae. The primary head lobe (Kopflappen), Reuter says, grows out between the proximal upper parts of the pedipalp coxae, and thus covers the cheliceral rudiments dorsally. "Dann verschmelzen die proximalen Teile der Pedipalpen unten median mit einander, oben mit den primären Kopflappen, wodurch ein vorn die

Mundöffnung enthaltendes, ringsum geschlossenes Gebilde entsteht." The simple structure of the capitulum in adult Notostigmata (fig. 23 A), as described by With (1904), is quite in accord with Reuter's account of the development in *Pediculopsis*.

Analyzing the capitular structure on a basis of comparative anatomy, Schulze (1932, 1935) contends that various elements besides the pedipalp coxae and the cephalic lobe enter into its composition. First, from a general study of the leg coxae of Ixodidae, Schulze deduces a concept of a primitive ixodid coxa (fig. 22 C) having an anterior process (*l*) projecting mesad of the trochanter (*t*), and an auricular lobe (*au*) on the outer angle. Along the anterior margin of the coxa a pleural fold, the "cymatium," is partly united with the coxa, but distally projects as a "processus cymatii" (*pc*) at the base of the anterior lobe. On the part of the cymatium adnate on the coxa is a porous area (*a*) of sense organs like those on the areae porosae of the capitulum. A small accessory fold (*s*) lies above the cymatial process.

The composition of the capitulum according to Schulze (fig. 22 D, E) is as follows: The pedipalp coxae ("Maxillae") form the major part of the basis capituli (Collare, or Kragen), but the trochanters must usually be included, since in certain ticks they appear as distinct basal segments of the palps (fig. 26 E, *t*). On the dorsal surface of the capitulum (fig. 22 D) the areae porosae (*a*) are derived from dorsomesal extensions of the porous areas of the coxal cymatia (*C*, *a*) united along the midline of the capitulum (*D*), while the small triangle (*k*) between their divergent anterior ends is formed from the primary cephalic lobe. On the ventral surface (*E*), the coxae (*c*, *c*) are united with each other proximally, but they embrace distally a plate (*II*) representing the deutosternum, which bears characteristically a pair of setae, and tapers distally in an "Unterlippe" (*u*) that forms the median basal part of the hypostome ("Clava"). The lateral toothed parts of the hypostome (*l*) are the anterior lobes of the primitive coxae (*C*, *l*) united with each other distally and with the sternal tongue between their bases. At the base of each coxal lobe of the hypostome appears the processes cymatii (*E*, *pc*), and laterad of this is a saddlelike piece, the "sella" (*s*), representing the small fold above the cymatium of the primitive coxa (*C*, *s*). Finally, a sub-coxal component is present as an invaginated extension from the base of the capitulum (*D*, *E*, *sc*). Schulze concludes with a tribute to the ingenuity of Nature, in that so many diverse parts can be brought together to form a unified structure for a specific purpose. We can

say only that it may be so, but that developmental evidence would be more convincing.

The mouth parts of the Acarina differ structurally from those of other Arachnida in no essential respect, as Börner (1902) has clearly shown. Recent writers, however, make no effort to correlate the acarine structure with that of arachnids in general, and their special terminologies become highly confusing; but, as Börner has said, since the mouth parts of the Acarina agree perfectly with those of other Arachnida, there is no need for the introduction of special terms for structures that already have generally applicable names. The review of the works of other writers that follows will show that the structural facts are fairly well known in several important acarine groups. The present writer has made no extensive study of the feeding organs of the Acarina, and, therefore, will attempt merely to bring the various published accounts together under a uniform terminology based on a concept of structural unity between the Acarina and other Arachnida. The terms used in the following descriptions may hence seem strange to acarologists, but few will deny the desirability of nomenclatural reform.

The only features of the acarine mouth parts that cannot be homologized with structures generally present in other Arachnida are the variously developed appendicular lobes or processes often associated with the distal part of the hypostome; lobes that are at least analogous with them, however, occur in the Chelonethida (fig. 12 A). These accessory hypostomal processes of the Acarina afford useful characters for specific descriptions, but each taxonomic writer usually has names of his own for them, or no names at all, and no attempt will be made here to invent a uniform terminology. The structures in question are evidently secondary lateral outgrowths of the coxal processes that are united in the hypostome; they are hence not "maxillary" processes, though in their various designations the maxillary idea seems to predominate. The structures might be called simply *hypostomal processes*. Usually, when present, there is a pair of them on each side, one member of which is lateral, the other mesal.

Notostigmata.—The capitulum and the mouth parts in this arachnid group, as described by With (1904), while in no sense primitive, show unquestionably an early stage in the evolution of the acarine capitulum. The tectum, termed "rostrum" by With, is a mere fold of the dorsal integument over the bases of the chelicerae (fig. 23 A, E, *Tect*), but it is united laterally with the high basal angles of the pedipalp coxae (A, *IIC.r*), and thus forms the dorsal wall of a primitive capitulum. From beneath the tectum project the large, fully exposed, three-

segmented chelicerae (*Chl*), which are but little invaginated at their bases. The chelicerae are typically arachnoid in form (*D*), and evidently are raptorial in function. Below the chelicerae is an elongate median plate (*C*, *Epst*) united laterally with the coxae and terminating in a free lobe that overhangs the mouth. With calls this entire plate "labrum," but he says it consists of a distal and a proximal part.

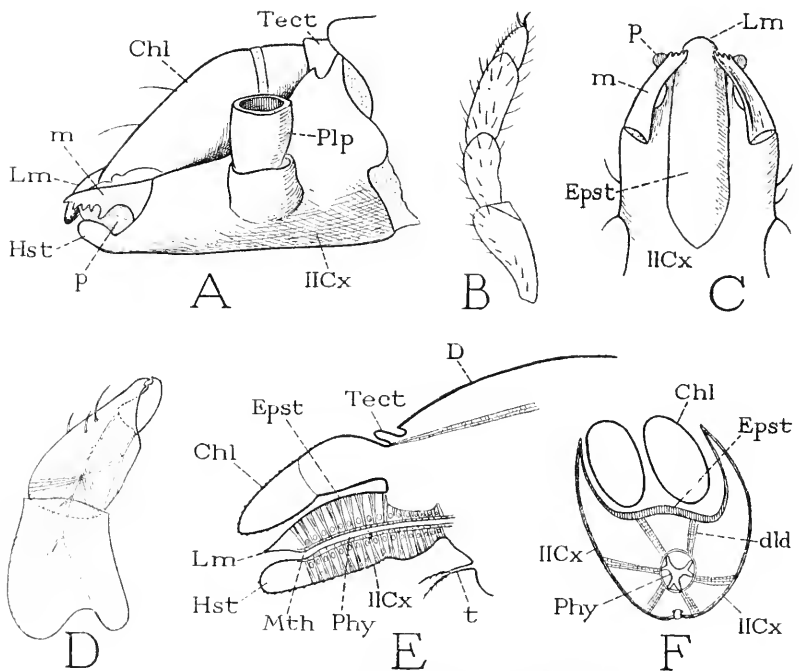


FIG. 23.—Acarina-Notostigmata, *Opiliacarus segmentatus* With (from With, 1904).

A, capitulum, left side: *m*, *p*, coxal lobes associated with the hypostome; *Tect*, tectum, or dorsal wall of capitulum. B, telopodite (palp) of pedipalp. C, dorsal surface of anterior part of capitulum below the chelicerae, showing apical lobes of coxae (*m*, *p*) and long epistomal plate (*Epst*) united laterally with the coxae. D, left chelicera, mesal. E, longitudinal section of capitulum and anterior end of body. F, transverse section of capitulum through pharynx, anterior to the tectum (E, *Tect*).

Since the proximal part is united with the pedipalp coxae and gives insertion to the dorsal muscles of the pharynx (E, F) it is clearly the epistome (C, E, F, *Epst*); the free apical lobe is the labrum (C, E, *Lm*).

The smooth, rounded under surface of the capitulum is extended forward beneath the labrum and ends in a pair of suboral lobes (A) that constitute the hypostome (A, E, *Hst*). At each side of the

hypostome is a pair of appendicular processes. In *Opiliacarus segmentatus*, as described by With, the outer process of each pair (*A, m*) is a toothed lobe articulated on the coxa, and is termed by With the "maxillary lobe"; the inner one (*f*) is a thin lamella distinguished as the "maxillary plate." The palps of the notostigmatid pedipalps are four-segmented beyond the coxa, and each bears a pair of pretarsal claws.

Proximal to the capitulum there projects from the ventral surface of the body a median bifid process (fig. 23 E, *t*), which is apparently a secondary development on the sternal region of the first-leg segment. Some writers term this structure the "labium," but the similar appendage in *Gamasides* was designated a "Bauchtaster" by Kramer (1876), who showed it has nothing to do with feeding, but probably has some function in connection with mating, since the genital orifice lies immediately behind it.

Oribatoidea.—In the scheme of acarine classification the sarcoptiform mites are not related to the Notostigmata, but the sectional figure by Berlese (1897) of the capitulum of a species described as *Oribates globulus*, probably *Euzetes seminulum* (O. F. Müller), given here at A of figure 24, shows a remarkably generalized condition of the mouth parts in combination with a well-developed capitulum. The tectum (*Tect*) is long and completely covers the retracted chelicerae (*Chl*). The short, two-segmented chelicerae, however, are typical chelate appendages, and, as shown in the figure, are merely invaginated beneath the tectum, so that each is contained in a pocket of the head wall inflected dorsally from the distal margin of the tectum, and ventrally from the base of the epistome (*Epst*). The epistome and the labrum (*Lm*) are together termed "labrum" by Berlese, but the epistomal region is clearly identified as such by the attachment on it of the dorsal pharyngeal muscles (*dld*), while the labrum is the free terminal lobe (*Lm*) projecting over the mouth. The ventral wall of the capitulum projects beyond the mouth (*Mth*), forming a short under-lip structure, or hypostome (*Hst*), with a median suboral lobe and a pair of lateral lobes. The pharynx (*Phy*) is of the usual structure. If this is a true picture of the oribatid structure, the latter is typically arachnoid except for the presence of the long dorsal wall of the capitulum, which covers the chelicerae, and this feature is merely an exaggeration of the structure in the Notostigmata.

Holothyroida.—In this group, as in the Parasitiformes, the chelicerae are elongate, deeply invaginated, and each is invested in a specific tubular sheath. The capitulum of *Holothyryus braueri* (fig. 24 B), as described and figured by Thon (1906), is covered dorsally

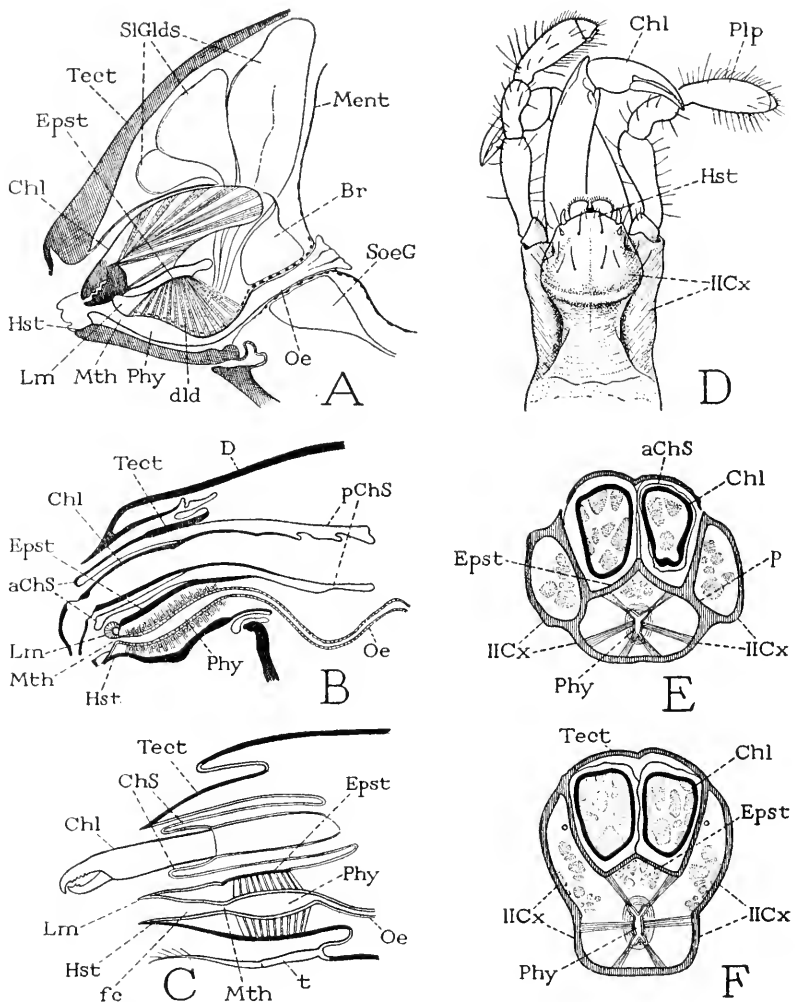


FIG. 24.—Acarina-Oribatoidea, Holothyroidea, Gamasides.

A, *Euzetes seminulum* (O. F. Müller), Oribatoidea, longitudinal section of capitulum (from Berlese, 1897). B, *Holothyrus braueri* Thon, Holothyroidea, longitudinal section of capitulum and anterior end of body (from Thon, 1906). C, *Poccilochirus carabi* Cn., Gamasides, diagrammatic representation from sagittal section of capitulum of male nymph by Winkler (1886). D, *Holothyrus braueri* Thon, Holothyroidea, capitulum, with palps and chelicerae (from Thon, 1906). E, same, cross section of anterior part of capitulum (from Thon, 1906). F, same, cross section of posterior part of capitulum (from Thon, 1906).

by a long duplicature of the prosomatic dorsum (D). The chelicerae (*Chl*), in the retracted state, are invaginated far into the body from between the tectum (*Tect*) above and the epistome (*Epst*) below. According to Thon the chelicerae are five-segmented, but since he says only two joints are articulations, it is evident that they are really three-segmented. The anterior parts of the cheliceral sheaths (*aChS*) are double tubular folds. The fold forming each outer sheath is extended dorsally from the tectum (*Tect*) and ventrally from the base of the epistome (*Epst*) to the end of the cheliceral shaft, where it is invaginated into itself to form the inner sheath more closely investing the chelicera and attached to the latter on the end of the basal segment. Thon describes also posterior cheliceral sheaths (B, *pChS*) reflected dorsally from the inner part of the tectum and ventrally from the epistome; but a posterior ensheathment of this kind is difficult to understand morphologically, and Thon, himself, says it probably results from some secondary modification.

The long epistomal plate of *Holothyryus* (fig. 24 B, *Epst*), called "labrum" by Thon, underlies the cheliceral sheaths and gives attachment to the dorsal muscles of the pharynx (E, F, *Phy*); laterally it is united with the mesal walls of the pedipalp coxae (E, *HCx*). Distally the epistome bears a small spiny lobe (B, *Lm*) overhanging the mouth (*Mth*). The interior of the lobe is filled with radiating columns of fibrous tissue, and the organ is provided with a pair of depressor muscles arising on the epistome. This movable, spine-covered lobe evidently has a rasping function, and for this reason Thon calls it the "Radularorgan"; there can be no question, however, that it is the labrum in an unusual form.

The lower wall of the capitulum of *Holothyryus* (fig. 24 D) has a three-lobed appearance owing to lengthwise indentations along the sides (E, F). Anteriorly the coxal cavity is divided into three compartments by partitions (E, *p*) inflected from the margins of the epistome to the coxal grooves, but posteriorly the partitions are absent (F). The distal end, or hypostomal region, of the ventral wall of the capitulum (D, *Hst*) bears a pair of broad median lobes and a pair of small lateral processes suggestive of the four apical appendages in the Notostigmata. The relatively long palps (D, *Plp*) are five-segmented but appear to lack pretarsal claws.

Gamasides.—The capitulum is said by Winkler (1886) to be well developed in all Parasitidae, but ventrally the segment of the first legs closely adjoins the capitulum (fig. 25 A, B) and projects with it from the anterior cavity of the body. A bifid ventral process (*t*) arises from the tritosternal region as in Notostigmata. The chelicerae are

long, three-segmented, and chelate (fig. 24 C, *Chl*). Each chelicera is invested in a membranous sheath (*ChS*) inflected from the distal end of the tectum and the inner end of the epistome, and then reflected forward in a fold that again turns back within itself to the distal end of the basal segment of the contained chelicera.

The diagram here given (fig. 24 C) is a free translation of the essential structure in Winkler's sectional figure of a male nymph of *Poecilochirus carabi* Cn. Below the chelicerae are the epistome (*Epst*), termed the "intermaxillary Chitingerüst" by Winkler, and the elongate labrum (*Lm*). The labrum ("Zunge"), Winkler says, is movable up and down, and also retractile by muscles inserted on its base, and is pressed like a wedge into a groove of the hypostome.

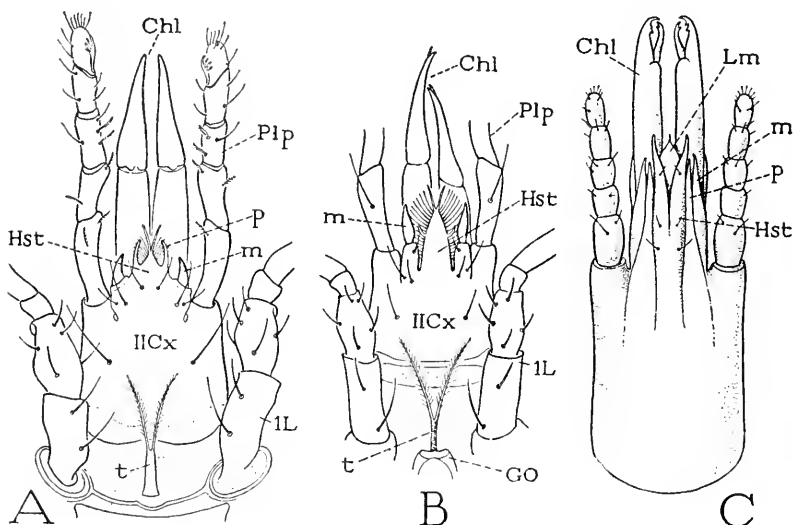


FIG. 25.—Acarina-Gamasides.

A, *Parasitus crassipes* (L.), female, capitulum and first body segment, ventral (from Winkler, 1886). B, same, male (from Winkler, 1886). C, *Laelaps echidninus* Berl., capitulum, ventral (from Stanley, 1931); *m*, *p*, coxal processes associated with the hypostome.

The under surface of the capitulum is prolonged beyond the mouth into a hypostomal under-lip structure (fig. 24 C, *Hst*). In *Parasitus crassipes* (L.) figured by Winkler (fig. 25 A, B) the hypostome presents a median lobe fringed with long hairs, which is much longer in the male (B) than in the female (A), and bears on each side a slender process (*p*) and a small lateral lobe supporting a knifelike or scalpel-shaped process (*m*). These hypostomal details, Winkler says, show much variation in different species.

The paper by Steding (1924) on *Halarachne otariae* Stedl., a species found in the nasal cavity of the California otter, does not give much concise information on the mouth parts, and the figures are somewhat sketchy, but the structure evidently is not essentially different from that of other Gamasides. The chelicerae are said to be enclosed in sheaths, but the sheath connections are not shown in a sectional view of the head. A subchelicerai epistomal plate is clearly depicted in a cross section, giving attachment to the dorsal muscles of the pharynx. The term "Oberlippe" evidently refers to the tectum, since Steding says it is a prolongation of the dorsal edge of the body, but the true labrum is seen in a sectional figure as a lobe projecting over the mouth from the epistome.

The description of the mouth parts of *Laelaps echidninus* Berl. given by Stanley (1931) presents some details more clearly than the earlier papers on Gamasides, but in certain respects it is difficult to understand, and the terminology is confusing. The chelicerae are called "mandibles," the dorsal wall of the capitulum (tectum capituli) is said to be prolonged in a long, flaplike "epistome"; the large labrum, with its ventral surface continuous into the dorsal wall of the pharynx, is termed the "lingula," and a long dorsal lobe of the labrum is named the *vomer*. The under surface of the vomer is described as being grooved and fitting over a dorsal ridge of the "lingula." The vomer is a structure not described by other writers. The chelicerae are said to be enclosed in sheaths, but the connection of the sheaths with surrounding parts are not clearly shown. The long hypostome is split into two tapering lobes (fig. 28 I, *Hst*), and from the coxal area at each side of it arise two slender, sharp-pointed processes. The lateral process (*a*) Stanley calls the "stylus," the mesal process (*b*) the "maxilla"; the two processes on each side are loosely locked together by a ridge on the "stylus" received into a groove of the "maxilla."

Ixodidae and Argasidae.—The ticks have a well-developed capitulum with strongly sclerotic walls (fig. 26 A-D); a wide basal extension (lined in the figures) fits into the so-called "camerostome," and is mostly covered in the retracted position of the head (C). On the exposed dorsal surface proximal to the palps in the female are two *areae porosae* (A, *ap*), presumably sensory. Between the palps the capitular wall is prolonged into the dorsal walls of tubular sheaths (*Chs*) enclosing the chelicerae. The ventral wall of the capitulum (B, C) is extended between the palps to form the large hypostome (B, *Hst*), which may be parallel-sided or somewhat spoon-shaped, and is generally armed below with strong retrorse teeth. The cheliceral sheaths with the contained chelicerae, and the hypostome constitute

a veritable *rostrum*, from the end of which project the movable, laterally toothed digits of the chelicerae. The upper concave surface of the hypostome has a median gutterlike groove (fig. 28 J, K, *hg*) that leads back to the mouth and is the floor of the food conduit within the rostrum.

The palps are freely movable on the capitulum. Each consists typically of four segments (fig. 26 A, B), of which the first is a small basal ring, the second and third are long and broad, while the fourth is a small hairy pad or papilla set in a membranous area on the mesal side of the end of the third segment (B, C, G, H). In *Dermacentor*, however, the apparent basal segment of the palp (C) is immovably united with the second segment, and in *Boophilus* (G) a basal segment is not distinguishable from the second. In the females of certain species of *Endopalpiger* from New Guinea and Australia, Schulze (1935) has shown that the basal segments of the palps are produced into large lobes embracing the rostrum (E, *t, t*). These segments Schulze regards as the trochanters of the pedipalps, which in other species and in the males of these same species are supposed to be incorporated in the capitulum, the long third segment of each palp, being interpreted as the usual second and third segments united. A smaller lobe arising from the base of the palp in *Ixodes auritulus* Newm. (F, *l*), however, is regarded by Schulze as pertaining to a secondarily separated proximal ring of the first segment. Superficially, it is not clear that this lobe and the supposed trochanters of *Endopalpiger* are not equivalent structures, and it seems strange that free trochanters should be retained only in the females of a few species.

The chelicerae of the ticks are long shafts deeply buried in the capitulum, or even projecting beyond the capitulum into the body, and each is enclosed in a membranous sleeve-like sheath. Distally each chelicera bears a free, strongly toothed segment, or *digit*, movable by a pair of antagonistic muscles arising in the shaft, and therefore representing the movable finger of a typical chelicera. The digit consists of two principal parts (fig. 26 J, K); one is a rigid prolongation (*a*) from the base of the segment, with a pair of outwardly directed teeth at its apex; the other (*b*) is a broad lateral lobe with two large teeth, flexibly attached to the side of the fixed process. In *Ixodes* (I) there is a third, dorsal process, but in some other genera as in *Amblyomma* (J) and *Dermacentor* (K, L), a large, thin membranous fold (*c*) arises dorsally from the base of the digit and covers the toothed processes. Finally, the end of the cheliceral shaft is produced into a hoodlike protective lobe (*h*) on the mesal side of the digit. The digits move in a transverse plane on the ends of the shafts,

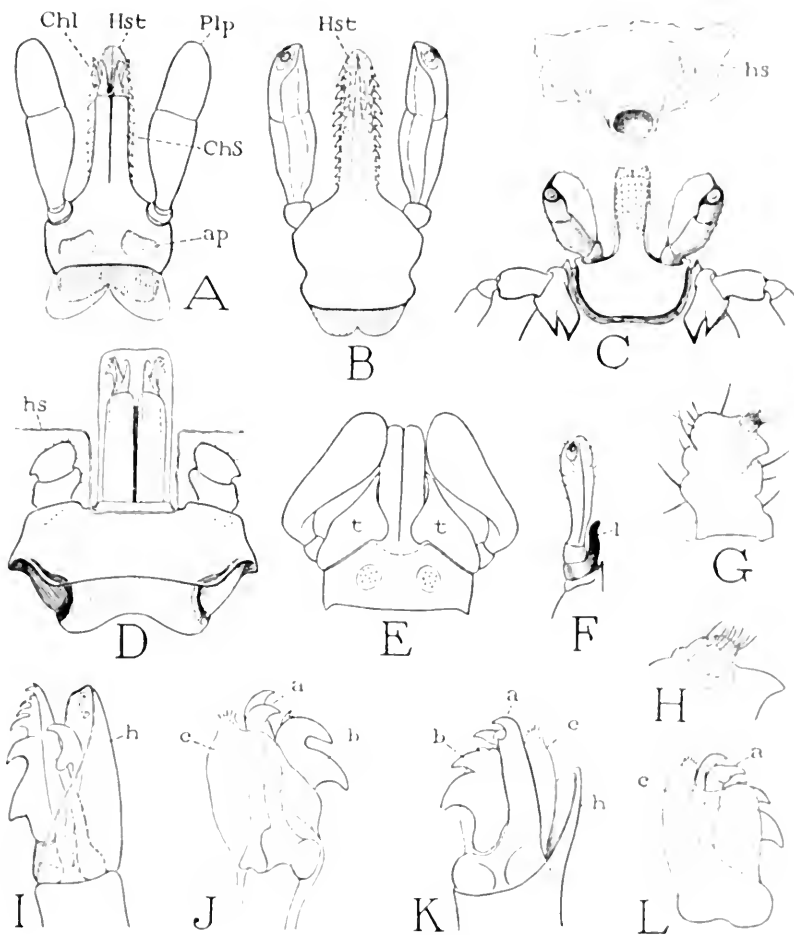


FIG. 26. Acarina-Ixofidæ

A, *Ixodes ricinus scapularis* Say, caputulum, dorsal. B, same, caputulum, ventral. C, *Dermacentor variabilis* (Say), caputulum and first legs, ventral, and papilla of host's skin from which the rostrum of the tick was extracted. D, *Boophilus annulatus microplus* (Can.), caputulum, dorsal; *hs*, outline of skin of host ensheathing the rostrum. E, *Ixodes (Endogalopsis) tomanni tomanni* Schulze, female, caputulum, dorsal, showing large basal lobes (*t*, *t*) of palps (from Schulze, 1935). F, *Ixodes auritulus* Newm., female, palp with basal lobe (*l*) (from Schulze, 1935). G, *Boophilus annulatus microplus* (Can.), palp. H, same, apical segment of palp. I, *Ixodes ricinus scapularis* Say, end of left chelicera, dorsal. J, *Amblyomma maculatum* Koch, right cheliceral digit, dorsal. K, *Dermacentor variabilis* (Say), end of right chelicera, ventral. L, same, digit of right chelicera, dorsal.

a, main shaft of cheliceral digit; *b*, toothed lateral lobe of digit; *c*, membranous dorsal lobe of digit; *h*, protective extension (hood) from shaft of chelicera.

so that the cutting action of their teeth is in a lateral direction. The shafts are protractile and retractile within the sheaths. On their bases are inserted the usual cheliceral muscles, which here serve as retractors; protraction is said to be produced by a bulblike compression of the body effected by the dorsoventral somatic muscles.

The exact method by which a tick "bites" perhaps needs more study than has been given to it. Sharif (1928) observes that the palps of a feeding tick are pressed against the skin of the host, and that the initial incision must be the work of the chelicerae, which cut the skin to admit the blunt tip of the hypostome and enable the latter to be pushed into the wound. According to Cooley and Kohls (1944) the hypostome in the argasid genus *Antricola* has only very small teeth, while the chelicerae are large and effective cutting organs. The mouth parts of these ticks, therefore, are "adapted for quick feeding and not for clinging to the host." In preserved specimens of *Dermacentor*, *Amblyomma*, and *Boophilus* that have been detached with a piece of the host's skin, the rostrum of the tick is ensheathed to its base in a conical or sleeve-like papilla extended from the flat surface of the integument, and the sides of the papilla are clasped by the concave mesal surfaces of the palps. Figure 26 C shows a papilla from which the rostrum of the tick below has been removed, and at D the line *hs* indicates the position of the papilla ensheathing the rostrum. If the papilla results from the forcible detachment of the tick, the teeth of the hypostome should be holding at its distal end; on the contrary, the hypostome in all cases is completely enclosed with its toothed extremity at the bottom of the tube. In these specimens, therefore, it would appear that the skin of the host has grown out around the rostrum of the tick. Portman and Dalke (1945) report finding numerous larvae, nymphs, and adults of *Amblyomma americanum* buried in the skin of a fox, presumably as a result of local swellings of the host tissue that had engulfed the parasites.

The ticks are said to have a keen sense of odor perception. In the Ixodidae the organs of smell, known as Haller's organs, are groups of innervated hairs in cavities on the tarsi of the first pair of legs. When these legs are amputated, according to Totze (1933), the tick gives no reaction to odor, but will feed through a moist, warm, artificial membrane on blood or most any kind of liquid, such as chemical solutions, even strong-tasting substances, showing that it has no gustatory sense. Presumably, then, the ticks recognize an animal as its proper source of food by a sense of smell, and the combination of warmth and moisture from the skin gives the stimulus for feeding.

The cheliceral sheaths are double-walled tubular folds of the capitular integument extended individually around the shafts of the chelicerae. In figure 27 the sheaths are represented diagrammatically as they are shown by Douglas (1943) in *Dermacentor andersoni*. The outer wall of each fold, or *outer sheath* (*oChS*), is produced forward from the dorsal wall of the capitulum above (*Tect*), and from the base of the labrum (*Lm*) below to the end of the cheliceral shaft; it is then invaginated into itself to form an *inner sheath* (*iChS*) closely investing the chelicera. In *Dermacentor variabilis* the cheliceral sheaths appear to be the same as in *D. andersoni*, but in *Argas*

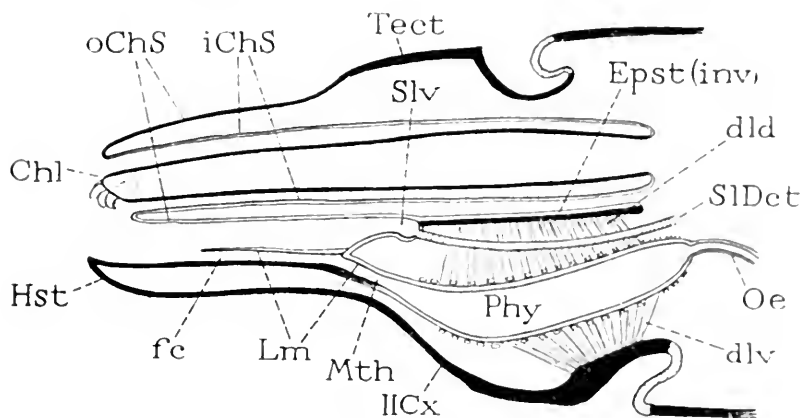


FIG. 27.—Acarina, diagram of the structure of the capitulum in longitudinal section.

Chl, chelicera; *dld*, dorsal dilator muscles of pharynx; *dlv*, ventral dilators of pharynx; *Epst*, epistome, invaginated; *fc*, food canal; *Hst*, hypostome; *IICx*, pedipalp coxa; *iChS*, inner cheliceral sheath; *Lm*, labrum ("styletlike process"); *Mth*, mouth; *oChS*, outer cheliceral sheath; *Oe*, oesophagus; *Phy*, pharynx; *SlvDet*, salivary duct; *Slv*, salivarium; *Tect*, tectum (dorsal wall of capitulum).

persicus, described by Robinson and Davidson (1913, '14), and in *Ornithodoros coriaceus*, described by True (1932), the lower wall of each inner sheath tube is said to be united for a part of its length with the upper surface of the subcheliceral plate (fig. 28 A, *Epst*).

The subcheliceral plate of the ticks is clearly the epistome (fig. 27, *Epst*), since it supports the labrum (*Lm*) at its distal end, and gives attachment on its ventral surface to the dorsal dilator muscles of the pharynx (*dld*). Inasmuch, however, as the ventral folds of the cheliceral sheaths arise at the base of the labrum in the Argasidae (fig. 28 A) it is evident that in these ticks the epistome is entirely invaginated. Christophers (1906), in fact, describes the epistome of *Ornithodoros* as an endoskeletal plate arising from a transverse bar

at the base of the labrum, composed of two strong lateral arms blended medially to form a long horizontal plate projecting freely into the body cavity. The subchelicerel plate of *Argas persicus* is said by Robinson and Davidson to be thin medially, but strengthened along the sides by marginal thickenings (fig. 28 L, *Epst*). The plate serves the dual purpose of furnishing a smooth surface on which the chelicerae slide, and of giving attachment ventrally to the dorsal dilator muscles of the pharynx (*dld*). The descriptions of *Ixodes ricinus* by Samson (1909), and of *Derma-centor andersoni* by Douglas (1943) are not specific concerning the nature of the epistome. Douglas makes the obscure statement that the buccal cavity "is formed in the subchelicerel plate," but in his figure A on plate 15 he shows dorsal muscles of the pharynx attached on subchelicerel sclerites, which must be the thickened lateral parts of an epistomal plate. True (1932) represents the subchelicerel plate of *Ornithodoros coriaceus* as given by Robinson and Davidson for *Argas persicus*.

From the end of the subchelicerel plate, or epistome, there projects over the mouth a small lobe (fig. 27, *Lm*), which is inserted into the widened proximal end of the gutter of the hypostome. Samson (1909) refers to this structure in *Ixodes ricinus* as a thin plate, shown in sectional view as a short flap extending over the mouth; Christophers (1906) observed it in *Ornithodoros savignyi*, but mentions it only as a small tongue protecting the pharyngeal orifice; Robinson and Davidson (1913, '14) describe the same thing in *Argas persicus* as a "tongue-like process," and show it in section as a tapering lobe (fig. 28 A, *Lm*) projecting over the mouth. Later writers have noted what appears to be a slender rod extending forward from the apex of the lobe, and have termed the whole structure the "styletlike process," or "tonguelike process" (fig. 28 E, *Lm*). Much has been written concerning the nature of this organ. Sen (1935) contended that the "stylet" is an open tube, the lumen of which is continuous into that of the pharynx, and that the mouth of the ticks is therefore a minute orifice at the apex of the stylet. Douglas (1943) accepts this interpretation, and represents the pharynx of *Derma-centor* as opening through the narrow tip of the stylet. Bertram (1939) and Arthur (1946), however, have shown that the stylet is an imperforate process projecting *above* the mouth, and normally lying over the gutter of the hypostome (fig. 28 J, *Lm*).

In *Ixodes*, *Derma-centor*, and *Amblyomma* the so-called "stylet" is long and slender; when pulled away from the hypostome there is usually to be seen attached to each side of it a narrow, very delicate membrane with an irregular and apparently broken margin (fig. 28 B,

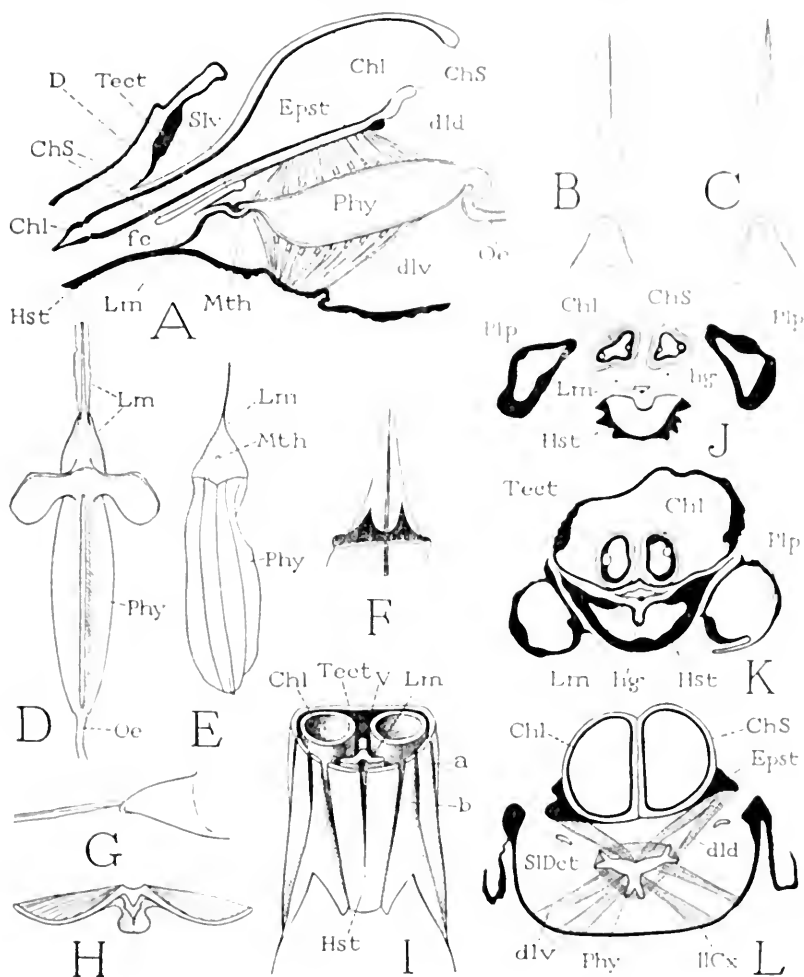


FIG. 28.—Acarina—Ixodidae, Argasidae, Laelaptidae.

A, *Argas persicus* (Oken), longitudinal section of capitulum (from Robinson and Davidson, 1913, '14). B, C, *Dermacentor variabilis* (Say), examples of the labrum as obtained by dissection (margins of apical blade broken). D, same, pharynx and labrum, dorsal. E, *Ixodes ricinus* L., pharynx and labrum, dorsal (from Arthur, 1936). F, *Ornithodoros tholozani* (L. and M.), labrum ("tongue-like process") (from Bertram, 1939). G, *Dermacentor variabilis* (Say), labrum, lateral. H, *Dermacentor andersoni* Stiles, anterior wing plates of pharynx with muscles, and section of oral aperture, posterior (from Douglas, 1943). I, *Laelaps echidninus* Berl., basal half of rostrum, ventral, showing arrangement of the mouth parts (from part of figure by Stanley, 1931); a, b, lateral processes of the rostrum. J, *Ixodes ricinus* L., transverse section of mouth parts and palps (from Arthur, 1936). K, *Argas persicus* (Oken), transverse section of hypostome (from Robinson and Davidson, 1913, '14). L, same, transverse section of capitulum through pharynx (from Robinson and Davidson, 1913, '14).

C). The filamentous axial "stylet," in fact, is the midrib of a long, thin blade that covers at least the proximal two-thirds of the hypostomal gutter, the edges of which become torn by removal from the hypostome. Whether the marginal membranes are attached to the hypostome, or are merely closely adherent to it, the writer has not been able to determine by dissection; but Robinson and Davidson in their figure of a transverse section of the capitulum of *Argas persicus* (fig. 28 K) show the "stylet" (*Lm*) with wide lateral expansions lying free above the hypostomal gutter (*hg*), and the organ of *Ornithodoros* is very clearly depicted by Bertram as a flat tapering blade (*F*) lying over the proximal part of the gutter of the hypostome.

Considering the relations of the "styletlike process" of the ticks to the epistome behind it and to the mouth below it, there can be no question that the organ so called is the *labrum* (fig. 27, *Lm*); it corresponds exactly with the labrum of other arachnids, and in form is suggestive of the labrum of a phalangiid (fig. 16 D, H, *Lm*). Börner (1902) notes that the labrum of the Ixodidae is much reduced. The ixodid labrum, however, though small in size, is differentiated into a conical basal lobe, and a thin bladelike distal extension. The basal lobe overhangs the mouth; the apical blade, which varies in length in different species, lies over the gutter of the hypostome. The covered part of the hypostomal gutter is thus converted into a closed canal that leads back to the mouth, and this canal, as Bertram has shown, must be the food conduit (fig. 27, *fc*). Bertram (1939) gives a long discussion of the "tongue-like process" in *Ornithodoros*, in which he discards the impossible suggestion of Sen that the process corresponds with the hypopharynx of insects; it is difficult to see how he missed the obvious fact that the organ is the labrum.

A comparison of the mouth parts of the Ixodides with those of Gamasides in which the tapering labrum reaches to the end of the hypostome (fig. 24 C) will show the identity of structure in the two groups. The relation of the parts in the proboscis of *Laelaps echidninus* is clearly seen in the figure by Stanley (fig. 28 I), who says that a groove on the ventral surface of the "lingula" (labrum) extends into the mouth of the pharynx and probably aids in the flow of blood from the wound.

In longitudinal sections of the capitulum of Ixodides the labrum, of course, looks like a stylet, and in dissections the marginal membranes of the apical blade are sometimes lost entirely, so that the axial filament appears to be a slender rod projecting from the apex of the basal lobe, as it is usually shown in illustrations (fig. 28 E). Moreover, the end of the organ is often broken, and may be split,

which fact possibly explains Douglas' statement that the "stylet" of *Dermacentor andersoni* is "tripartite and quite short."

Above the basal lobe of the labrum is a flat pocket (figs. 27, 28 A, *Stv*) covered dorsally by the lower walls of the cheliceral sheaths. Into the inner end of this pocket open the ducts of the salivary glands (fig. 27, *SIDct*). The supralabial pocket thus serves as a salivarium, or receptacle for the saliva ejected from the ducts. Christophers (1906), however, regarded it as the "mouth cavity," and Nuttall, Cooper, and Robinson (1908) called it the "buccal cavity," which terminology has been followed by more recent writers. It is clear, however, that the space in question has no relation to the mouth or to the intake of food; it is appropriately named by Samson (1909) the "Speichelhöhle." The closure of the food canal of the hypostome by the labrum must exclude the saliva from direct entrance into the mouth; its only access to the food stream, then, would appear to be at the open distal part of the hypostomal gutter.

The flow of saliva from the salivarium pocket, according to Bertram (1939), is regulated by movements of the labrum ("tongue-like process"). The lumen of this organ in *Ornithodoros*, Bertram says, is a closed chamber, presumably filled with liquid, the posterior end of which extends into the pharynx against the anterior part of the dorsal wall of the latter, and therefore reacts to changes of pressure within the pharynx. The decreased pressure of the expanding pharynx contracts the labral chamber and deflates the labrum; conversely, contraction of the pharynx dilates the labrum. The alternate expansion and contraction of the labrum is thus supposed to exert a sucking action on the saliva entering the salivarium from the salivary ducts. A similar mechanism has not been observed by other writers.

The pharynx of the ticks presents no special features in its general structure. It is an elongate sack (fig. 28 A, *Phy*) surrounded by a thick layer of constrictor muscle fibers, within which the walls, when contracted, are thrown into three radial folds (i. e., *Phy*). Dilator muscles arise dorsally (*dld*) on the thickened lateral margins of the subcheliceral epistomal plate (*Epst*), and ventrolaterally (*dlv*) on the lower walls of the capitulum. In *Dermacentor variabilis* two winglike plates diverge laterally and posteriorly from the anterior end of the pharynx at the base of the labrum (fig. 28 D). The similar plates of *D. andersoni* are shown by Douglas (1943) to give attachment on their concave dorsal surfaces to flat muscles (H) inserted medially in the base of the labrum ("stylet"). The under surface of the labrum is produced into a toothlike process that fits into a groove of the lower wall of the entrance to the pharynx. This structure Douglas regards

as a pharyngeal valve, since contraction of the plate muscles would constrict the V-shaped oral aperture. The wing plates of the valve are said by Douglas to be extensions of the pharyngeal wall; the operative muscles, therefore, are evidently the anteriormost fibers of the dorsal constrictors of the pharynx.

Trombidiformes.—Among the trombidiform mites the chelicerae become progressively adapted for piercing by a transformation of the movable digits into hooks or stylets. In the larvae of the chiggers (Trombiculidae), which are parasitic on vertebrate animals, the cheliceral digits are hook-shaped with the points turned upward; they are used for cutting into the skin of the host, but the mite does not otherwise penetrate the skin. André (1927) says the chigger grasps the surface of the host with its palps, and then pushes the cheliceral hooks into the skin. From the puncture of the feeding chigger a tube-like structure extends into the flesh, which was formerly thought to be a sucking organ of the mite, and was named the "stylostome." Its formation, however, as described by André, is due to the injection of a digestive liquid by the chigger, which diffuses through the host tissue, producing the wall of the tube and an edematous condition surrounding the latter, especially at the inner end. Ewing (1944) says the host tissue in immediate contact with the injected fluid "is liquefied, and the adjoining tissue becomes toughened. As the predigested liquefied tissue (not blood) is sucked up by the mite and more digestive fluid is injected into the cavity thus produced there is formed a sclerotized tube which may be as long as the total length of the mite itself."

The water mites (Hydracnidae), which feed on the larvae of aquatic insects, have long, straight, styletlike cheliceral digits. The feeding and digestion of these mites has been fully described by Bader (1938), who says the mites seize the prey with the palps and tear a hole in the skin with the chelicerae. For from 10 to 20 minutes the mite then quietly holds on to the victim, during which time the congested salivary glands discharge their secretion into the body of the prey and the tissues of the latter are thereby dissolved. Sucking now begins and continues until the mite is replete or the prey is empty of its contents. An *Anopheles* larva, Bader says, can be sucked dry by three individuals of *Hygrobates longipalpus*, leaving nothing but the empty skin. After the preliminary digestion by the salivary secretion, the final digestion of the food, as in other Arachnida, according to Bader takes place intracellularly in the digestive cells of the capacious stomach and its large diverticula. Since these mites have no posterior opening to the alimentary canal, the waste products of digestion accumulate in the stomach cells.

Specialization of the feeding organs for piercing is carried farthest in the Tetranychidae, the members of which family, known as spider mites, are plant feeders. The movable digits of the chelicerae of the tetranychid mites are drawn out into long, slender stylets with recurved bases attached on the proximal segments of the chelicerae in such a manner that they are individually protractile and retractile. The basal segments of the chelicerae, however, are united with each other to form for the stylets a common support, which is itself protractile and retractile beneath an anterior fold of the dorsum of the body. The epistome and the hypostome compose a conical rostrum containing the mouth and the pharynx. The dorsal surface of the epistome is deeply grooved to form a channel in which the cheliceral stylets slide back and forth. The pharynx is cup-shaped, with the dorsal wall invaginated in the form of a plunger, activated by muscles arising on the epistome. Two pairs of silk glands open by a common duct into the distal end of the epistomal groove, and the duct of an unpaired salivary gland transverses the united cheliceral segments to open beneath them anteriorly. Closely associated with the chelicerae are the two spiracular apertures of the tracheal system, which lie medially in the infolded membrane just behind the united parts of the cheliceral bases. From each spiracle a long, finely ribbed, external groove, known as a "peritreme," extends posteriorly and laterally in the dorsal integument; inwardly the spiracles open into a pair of vertical respiratory tubes with thick sclerotic walls supported below on an apodeme of the epistome. From the lower ends of these tubes a large tracheal trunk is given off on each side, from which issue bundles of finer tracheae distributed anteriorly and posteriorly throughout the body.

The feeding organs of *Tetranychus telarius* (L.) have been described in detail by Becker (1935) and by Blauvelt (1945), but the terminology used by these writers is likely to give the uninformed student the impression that the feeding organs of the tetranychids have little relation to those of other Acarina, as indeed the unusual features of these mites themselves would seem at first sight to suggest. However, it is not difficult to fit the descriptions of Becker and Blauvelt into an interpretation entirely in accord with that given here of the acarine feeding organs in general.

A dorsal view of the forward part of the body of *Tetranychus* (fig. 29 A) shows anteriorly, projecting from beneath a flexible fold (*df*) of the back, what appears to be a broad, heart-shaped plate (*Stphr*) with a rounded outline in front and a deeply notched margin behind. This structure is commonly called the "mandibular plate."

since on its under surface are attached the recurved bases of the cheliceral stylets (*Stly*); but for this same reason there can be no question that it represents the united basal segments of the chelicerae, as said by Becker (1935) and by Vitzthum (1940-'43, p. 809), and

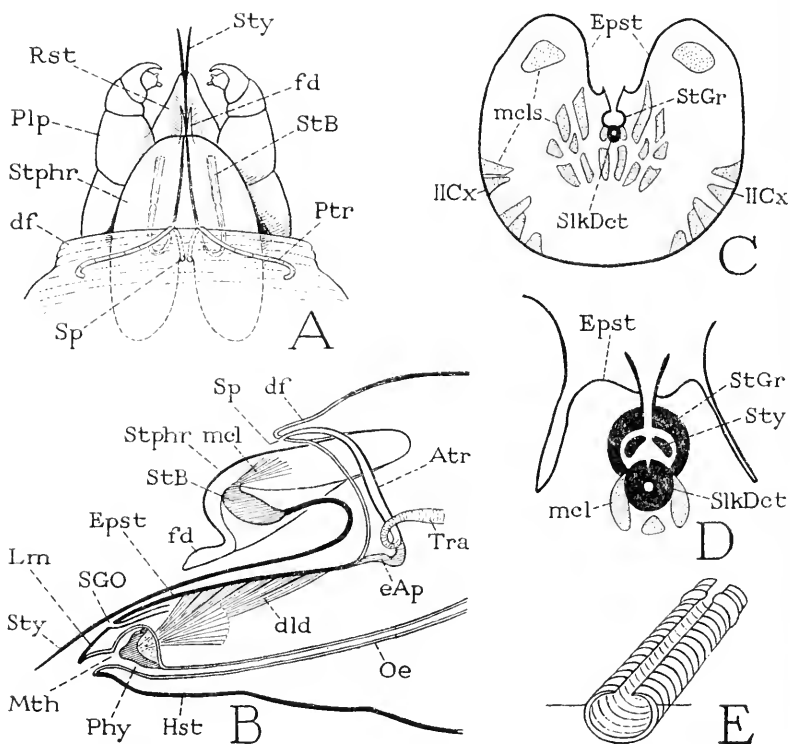


FIG. 29.—Acarina-Trombidiformes-Tetranychidae, *Tetranychus*.

A, dorsal view of capitulum and anterior part of body, showing the united cheliceral bases, or stylophore (*Stphr*), partly retracted beneath a marginal fold of the dorsum (*df*) covering the spiracles (*Sp*) and the infolded anterior ends of the peritremes (*Ptr*). B, diagrammatic interpretation of structure of feeding organs of *Tetranychus telarius* (L.) based on a lengthwise sectional figure by Blauvelt (1945, fig. 51), with parts somewhat separated for clarity of identification with corresponding parts of other Acarina. C, cross section of rostrum behind palps (from Blauvelt, 1945). D, cross section through stylet groove of epistome over the pharynx (from Blauvelt, 1945). E, piece of a pseudotracheal peritreme (from Blauvelt, 1945).

therefore might be termed more appropriately the "cheliceral plate," except for the fact that it is not a plate at all, but a thick lobe containing an extension of the haemocoel. The word *stylophore* (*Stphr*) suggests itself as a practical name. The rounded anterior surface of the stylophore is abruptly declivous (fig. 29 B) and bears ventrally

a pair of small thin processes (*fd*) that possibly represent the immovable cheliceral digits.

The cheliceral stylets (fig. 29 B, *Sty*) are attached apparently in deep anterior inflexions or pockets of the under surface of the stylophore (but the structure of the under surface of the stylophore as drawn in the diagram is somewhat conjectural). Each stylet has a flat pear-shaped base (*StB*) from which the strong but slender shaft extends first posteriorly and then loops downward and forward. On a projection of the stylet base, apparently dorsal to the articulation on the stylophore, is attached a group of muscle fibers (*mcI*), which, Blauvelt says, produce an up-and-down movement of the tip of the stylet. However, inasmuch as the stylets are closely held in the groove of the epistome (*D. Sty*), a downward rotation of their bases should cause a protraction of the shafts. Muscles antagonistic to the stylet protractors have not been observed, and it is possible that retraction results automatically from the elasticity of the stylets or of their basal connections. On the other hand, the principal movements of the stylets must be brought about by the protraction and retraction of the stylophore. The movements of the latter, according to Blauvelt, are produced by muscles from the dorsum of the body attached on the posterior lobes, and muscles attached distally in the stylophore that arise posteriorly on the vertical respiratory tubes. Both of these sets of muscles, however, would appear to be retractors, and it may therefore be supposed that, as in some other Acarina, protraction of the chelicerae is effected by a bulblike compression of the body.

The stylophore is capable of complete retraction beneath the marginal fold of the dorsum that ordinarily covers its basal half. This fold (fig. 29 A, B, *df*), projecting as it does over the cheliceral bases, possibly represents the tectum, or dorsal wall of the capitulum in other Acarina; if not, the tetranychid capitulum is incomplete dorsally, and is composed only of the coxal elements and the epistomal plate that unites their dorsal surfaces below the chelicerae, and forms the upper wall of the rostrum (B, *Epst*).

The rostrum (termed "hypostome" by Becker) projects as a short wide cone from between the bases of the palps (fig. 29 A, *Rst*). Its dorsal, or epistomal, wall is shown by Becker and by Blauvelt to form a trough (C, *Epst*) in which the stylophore ("mandibular plate") slides backward and forward. Along the bottom of the trough is a deep, thick-walled canal (C, D, *StGr*) that contains the shafts of the cheliceral stylets (D, *Sty*) and evidently serves to hold them in place during their functional activity. The common duct of the two pairs of silk glands runs beneath the stylet canal (C, D, *StDct*).

and, as already noted, opens into the distal end of the latter. If this duct represents the paired ducts of the salivary glands of the ticks that discharge above the base of the labrum (fig. 27, *SIDct*), the short apical part of the dorsal wall of the tetranychid rostrum projecting over the mouth may be referred to the labrum (fig. 29 B, *Lm*).

The hypostomal wall of the rostrum (*Hst*) is a simple ventral prolongation of the coxal region of the capitulum and has no appendicular accessories.

The mouth lies within the tip of the rostrum (fig. 29 B, *Mth*) and opens directly into the pharynx (*Phy*). The form of the tetranychid pharynx is unusual for a sucking apparatus, but is one characteristic of the salivary ejection pump of insects. By comparison with the tubular pharynx of other arachnids the cup-shaped sucking organ of *Tetranychus* is so short that the inflected dorsal wall takes the form of a thick conical plug with the dilator muscles (*dld*) from the epistome convergent upon its center. The oesophagus (*Oe*) proceeds in the usual manner from the posterior end of the pump chamber.

The respiratory system is an interesting feature of the tetranychid organization. Just why the spiracles should be in a place so inconvenient as the infolded membrane at the base of the united chelicerae is not clear (fig. 29 A, B, *Sp*), except that they are here by inheritance from prostigmatic ancestors. The so-called "peritremes" (*A*, *Ptr*), as above noted, are open channels of the integument that extend posteriorly and outward on the dorsal surface of the body from the spiracles. Their closely ribbed walls (*E*) give these channels a resemblance to tracheae, and, in fact, they might with better reason be termed *pseudotracheae* than are the similar canals on the mouth lobes of phalangiids and the labella of some Diptera that have to do with feeding and not with respiration. Blauvelt observes that the long, slitlike peritremes of *Tetranychus* give the spiracles access to the outer air at all usual positions of the chelicerae. It is evident that as they are pulled into the fold of integument over the cheliceral bases by the retraction of the latter, the indrawn parts of the canals are converted into closed tubes while the outer parts are still open to the air. When the cheliceral bases (stylophore) are fully retracted, however, Blauvelt says, the peritremes are completely shut off from the air, and this fact he points out "may explain in part the high degree of resistance of this mite to certain toxic gases such as hydrocyanic acid gas and nicotine vapor." The vertical respiratory tubes into which the spiracles open (fig. 29 B, *Atr*) are said to be enclosed in a common, strongly sclerotic wall, their ventral ends are supported on a median apodeme of the epistome (*eAp*), and the

tubes give attachment to retractor muscles of the chelicerae. These facts would suggest that the spiracular tubes are elongate atrial chambers, or secondary invaginations of the integument, rather than true tracheal trunks. From the lower end of each tube a large tracheal trunk (*Tra*) arises laterally, turns posteriorly, and gives off bundles of finer tracheae that aerate the entire body.

ABBREVIATIONS USED ON THE FIGURES

(Other lettering explained in the legends.)

- aChS*, anterior cheliceral sheath.
An, anus.
Ant, antenna (*1Ant*, *2Ant*, first and second antenna).
Ap, apodeme.
Atr, spiracular atrium.
- Br*, brain.
- cAp*, coxal apodeme.
Chl, chelicera.
ChlB, cheliceral base.
chlF, cheliceral foramen.
ChS, cheliceral sheath.
Cp, carapace.
cpr, compressor muscle.
Ct, cuticle.
Cuc, cucullus.
Cx, coxa (*IICx-VICx*, coxae of pedipalps and legs).
cxp, coxal process of pedipalp.
cxr, coxal ridge.
- D*, back of the body, dorsum.
Dac, dactyl, median claw of pretarsus.
dc, dorsal channel of pharynx.
Dct, duct.
df, fold of dorsum over bases of chelicerae.
dld, dorsal dilator muscles of pharynx.
dll, lateral dilator muscles of pharynx.
dvl, ventral dilator muscles of pharynx.
dpl, dorsal plate of pharynx.
dplcx, dorsal plate of pedipalp coxa.
dpptar, depressor muscle of pretarsus.
dpt, depressor tendon.
dptar, depressor muscle of tarsus.
dptb, depressor muscle of tibia.
- eAp*, epistomal apodeme.
ecAp, epistomocoxal apodeme.
ecs, epistomocoxal sulcus.
Endst, endosternum.
- Endt*, coxal endite (*IIEndt*, *IIIEndt*, *IVEndt*, coxal endites of pedipalps, first legs, and second legs).
Epst, epistome (clypeus, subcheliceral plate).
Epth, epithelium.
- f*, median frontal bar.
fc, food canal.
fd, immovable finger (fixed digit) of chelicera.
Fm, femur.
FrG, frontal ganglion.
- G*, ganglion (*IG*, tritocerebral ganglion, *IIG*, *IIIG*, ganglia of pedipalps and first legs).
GC, genital chamber.
Gld, gland.
GO, genital opening.
- HL*, head lobe of embryo.
hs, piece of skin of host drawn out in a papilla around the rostrum of ticks.
Hst, hypostome.
- I-III*, postoral somites (*I*, cheliceral somite).
iChS, inner cheliceral sheath.
- L*, leg (*1L-4L*, first to fourth legs).
lbrmcl, labral muscle.
IIIcl, labral haemocoelae.
li, lamina inferior of pedipalp coxa.
Lm, labrum ("lingula," "styletlike process").
lmd, lamina dorsalis of preoral cavity.
lmv, lamina ventralis of preoral cavity.
lpg, lophognath.
ls, lamina superior of pedipalp coxa.
lptar, levator muscle of pretarsus.
lvt, levator tendon.

- ltar*, levator muscle of tarsus.
lttb, levator muscle of tibia.
mcl, muscle.
Md, mandible.
Mes, mesenteron.
ml, mouth lobe of Solpugida.
Mth, mouth.
oChS, outer cheliceral sheath.
Oe, oesophagus.
Pat, patella.
pChS, posterior cheliceral sheath.
Pcr, protocerebrum.
Pdp, pedipalp (appendage of segment II).
pdpF, foramen of pedipalp.
Phy, pharynx.
Plp, palp (telopodite of the pedipalp).
PrC, preoral food cavity.
Prstm, prestomum.
Ptar, pretarsus.
Ptr, "peritreme," pseudotracheal groove leading to spiracle.
Pvent, proventriculus.
PvP, proventricular pump.
Rst, rostrum.
S, sternum (*IS-IVS*, sterna of first four segments).
Ser, serula.
SGO, silk gland opening.
SIDct, salivary duct.
SIGlds, salivary glands.
SlkDct, silk gland duct.
SoeG, suboesophageal ganglion.
Sp, spiracle.
Spn, spinneret.
StGr, stylet groove.
Stphr, stylophore.
Sty, stylet.
t, tendon.
Tar, tarsus (*1Tar*, *2Tar*, first and second tarsal subsegments, or tarsomeres).
Tb, tibia.
Tect, tectum capituli ("rostrum," "epistome").
tmcl, transverse muscle.
tfg, taphrognath.
Tr, trochanter (*1Tr*, *2Tr*, first and second trochanters).
Tra, trachea.
Un, unguis, lateral claw of pretarsus.
V'Gld, venom gland.
vpl, ventral plate of pharynx.
V'Pr, venom pore.

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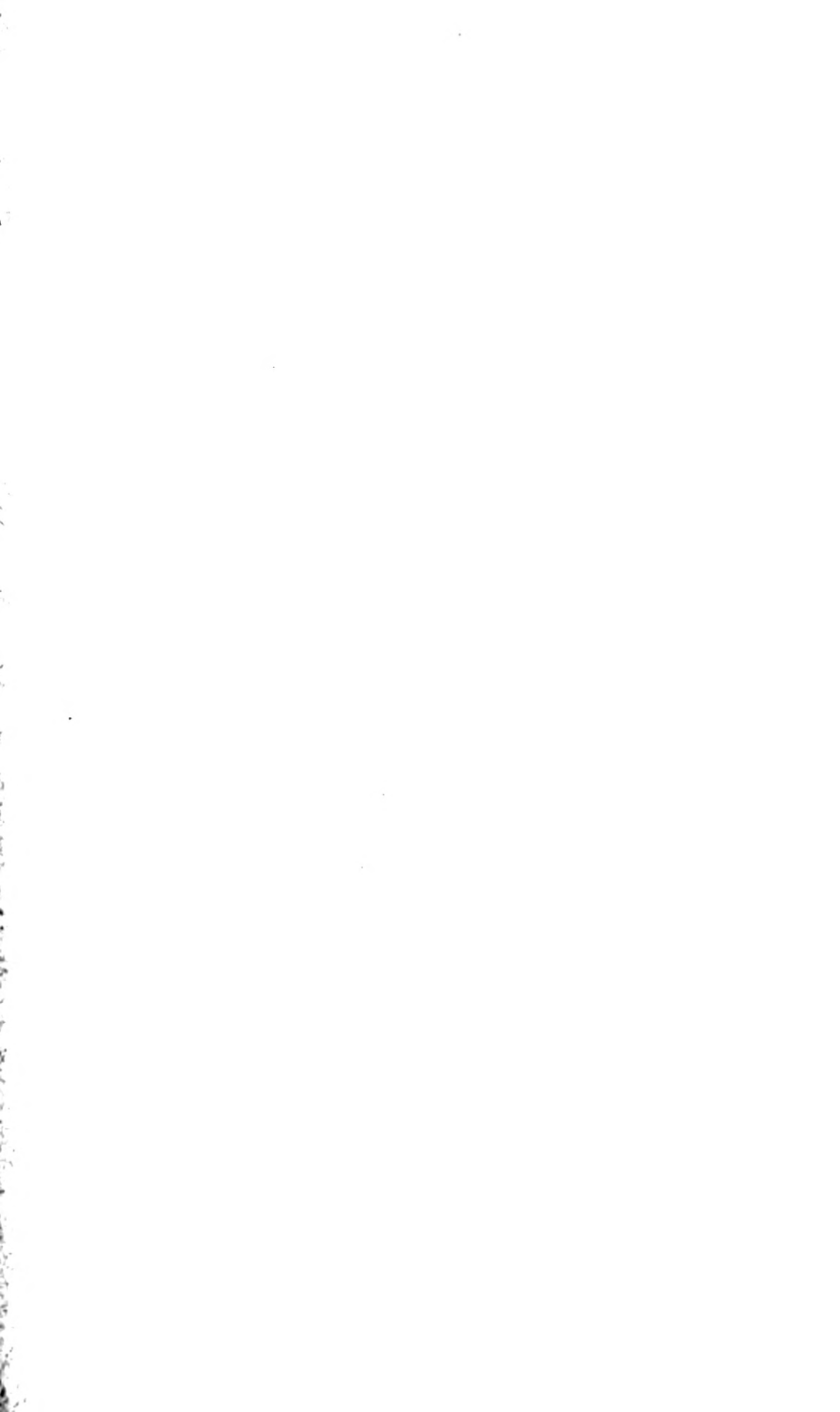
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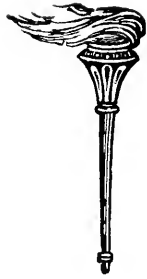
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SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 110, NUMBER 11

Roebling Fund

THE SMITHSONIAN STANDARD PYRHELIOMETRY

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(PUBLICATION 3945)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
AUGUST 5, 1948

The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

Roebling Fund

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Since 1910 nearly a hundred copies of the silver-disk pyrheliometer have been prepared at the Smithsonian Institution. They are in use in many countries. Observers, even those using other types of pyrheliometer, often express their results in terms of "the Smithsonian standard scale" which is carried to them by these silver-disk instruments, standardized against the water-flow pyrheliometer. Aldrich and Abbot, in 1947, made a painstaking comparison at Mount Wilson between two silver-disk instruments and the water-flow pyrheliometer. They obtained within one part in a thousand the same result as in 1934 and earlier.¹ Various observers have investigated old silver-disk instruments and find no evidence that there has been a change of their sensitiveness since 1910.

So the question of the standard scale depends on the adequacy of the water-flow pyrheliometer as a standard. Originally this instrument comprised a single deep test-tube-like blackened chamber of metal with hollow walls. In these walls, in the extreme rear wall, and in the walls of a hollow cone not quite at the rear, on which all the sun's rays fell directly, a current of water constantly flowed to carry off the solar heat as fast as absorbed. An electrical thermometer, meticulously calibrated by means of an extremely delicate standard mercury thermometer, registered the rise of temperature between the entrance and the exit of the stream of water. A carefully gaged diaphragm admitted the solar rays to the chamber. Other diaphragms of slightly larger diameter, along the vestibule and within the chamber, served the double purpose of opposing air currents, and of obstructing the entrance or the escape of stray light. The rate of flow of the water was determined by frequent weighings.

As all of the entering beam of sunlight fell upon the hollow blackened cone near the extreme rear of the chamber, over 95 percent of

¹ Aldrich, L. B., and Abbot, C. G., Smithsonian pyrheliometry and the standard scale of solar radiation. Smithsonian Misc. Coll., vol. 110, No. 5, 1948.

the rays would be immediately absorbed on that cone and would give up their heat there into the flowing water. The remaining 5 percent or less would be scattered over an entire hemisphere, of which nearly the whole solid angle was included in the blackened walls of the chamber. Over 95 percent of the trifling amount of radiation scattered from the cone, impinging upon these walls, would be absorbed on them, and this heat also would be communicated to the flowing water. Only the measured aperture, through which solar rays entered, was open to free escape of the scattered rays. As this aperture subtended but 0.012 hemisphere as viewed from the hollow cone, less than 0.012 of 5 percent of the introduced solar radiation could freely escape. So, theoretically, the chamber was fully 99.94 percent "black."

Lest some unforeseen error should lurk in the device, two coils of insulated wire were wound upon the cone. One coil was wound in shellac directly upon the rear wall of the cone, being behind the water stream within the cone, but in front of the water stream in the extreme back wall of the chamber. This coil was more favorably situated than solar heating to convey electrically produced heat to the flowing water. The other insulated coil was of several millimeters thickness, was doughnut-shaped, and was stuck on with shellac to the front rim of the hollow cone, outside the area covered by the beam of sunlight. This coil was very unfavorably situated to give up electrically produced heat to the flowing water, since it must first give its heat to the air, and then to the walls of the chamber.

I have been describing Standard Pyrheliometer No. 3. On pages 61 and 63 of *Annals of the Smithsonian Astrophysical Observatory*, volume 3, 1913, there are given 24 tests, half with each of the two heating coils, where electrically introduced heat was measured by absorption in the flowing water. The results of 12 tests at Washington, April 18, 22, and 23, 1910, showed no certain difference as between the two coils, and gave a mean result of 99.85 percent heat found. The results of 12 tests at Mount Wilson, October 10 and 11, 1911, also equally divided between the two coils, gave 100.66 percent heat found. These results come to well within their probable error at exactly 100 percent heat found. They therefore indicate that heat introduced in the chamber, no matter whether more or less favorably for measurement than solar heat, is completely absorbed and accurately measured by the instrument. This, as we shall see later, is a critically important result.

Not content with this method of fixing the standard scale of pyrheliometry, we constructed another instrument of the hollow-chamber type. It was called the water-stir pyrheliometer, because, instead

of carrying off absorbed heat in a flowing stream of water, the chamber was immersed in a water bath whose rate of rise of temperature, and cooling corrections, were observed after the methods of exact calorimetry. In this instrument only one insulated coil of wire was introduced, but it was wound in part within the wall of the sides of the chamber. Thus it had almost identically the same facility to give up its heat to the water as did the solar rays. Tests of electrical heating with this instrument were made on October 24 and 26, 1912, and recorded on page 67 of *Annals*, volume 3. Six tests gave 100.05 percent of heat found, and the results are even more consistent than the excellent ones with the water-flow pyrheliometer. Silver-disk pyrheliometer APO S_{disk} , which we have ever since used as secondary standard, was compared on a number of occasions from 1910 to 1912, some at Washington, others at Mount Wilson, and with both the water-flow and the water-stir standards. The results are given at the bottom of page 70, *Annals*, volume 3. They give the following independent determinations of the constant for APO S_{disk} : 0.3798, 0.3791, 0.3809, 0.3786, 0.3792, 0.3770, 0.3772.

Many years later the silver-disk pyrheliometers were altered to have longer vestibules so as to reduce the angular area of sky near the sun to which they were exposed. The water-flow standard pyrheliometer was also changed. A Russian, V. M. Shulgin, made the valuable suggestion that by using two chambers rather than one in the water-flow pyrheliometer, with the water stream divided just at the entrance of their walls, inequalities in rate of water flow would be the same in both. Hence if the solar heating in one chamber was continually being balanced by electrical heating in the other, the inequalities of flow of water would cease to produce fluctuations in the readings. In 1932 we introduced Shulgin's method, and, *depending on the results of 1910 to 1912, to the effect that solar heating and electrical heating are equally efficiently absorbed*, all subsequent standardizations of pyrheliometers by Smithsonian observers are based on the use of the standard water-flow pyrheliometer *as an electrical compensation instrument*. That is, we no longer measure the water-flow rate, or the rise of temperature of the water, but we balance solar heat in one chamber against electrical heat in the other, and reverse chambers as respects heating again and again. I repeat, *we now absolutely depend on the experiments I have quoted, of the years 1910 to 1912*, which prove that in our pyrheliometer electrical heat and solar heat are both fully absorbed in the water stream.

Prior to the adoption of V. M. Shulgin's suggestion of using two chambers in the water-flow pyrheliometer, we found great difficulty

in producing a constant water stream. Air bubbles were carried along, and local fluctuations in temperature occurred owing to air currents affecting the short rubber tubes which had to be introduced to allow free movement. These irregularities, both of mechanical and heat natures, caused accidental differences of successive measurements so appreciable that great numbers of comparisons with silver-disk pyrheliometers had to be made to obtain accurate results. What with this source of error, and the effect of sky radiation from near the sun, which was minimized by using the longer vestibules of the silver-disk pyrheliometers after the year 1925, we found that the earlier determinations of the constants of silver-disk pyrheliometers were too high by 2.3 percent. This correction we published in the year 1934.² Nevertheless, so as not to upset the world's system of pyrheliometry, and the comparability over a long term of years of Smithsonian solar-constant results contained in volumes 2 to 6 of *Annals of the Smithsonian Astrophysical Observatory*, while we admit that the 1913 scale of pyrheliometry is 2.3 percent too high, we and those who follow us still use the Smithsonian scale of 1913.

The variability of the brightness of the sky may still slightly affect silver-disk pyrheliometry. However, as stated at pages 53 to 55, *Annals*, volume 6, we now eliminate variations of sky brightness as a source of error in solar-constant measurements.

² Abbot, C. G., and Aldrich, L. B., *The standard scale of solar radiation*. Smithsonian Misc. Coll., vol. 92, No. 13, 1934.

SMITHSONIAN MISCELLANEOUS COLLECTIONS
VOLUME 110, NUMBER 12

THE
DRUM MOUNTAINS, UTAH,
METEORITE

(WITH FIVE PLATES)

BY

E. P. HENDERSON

Associate Curator, Division of Mineralogy and Petrology

AND

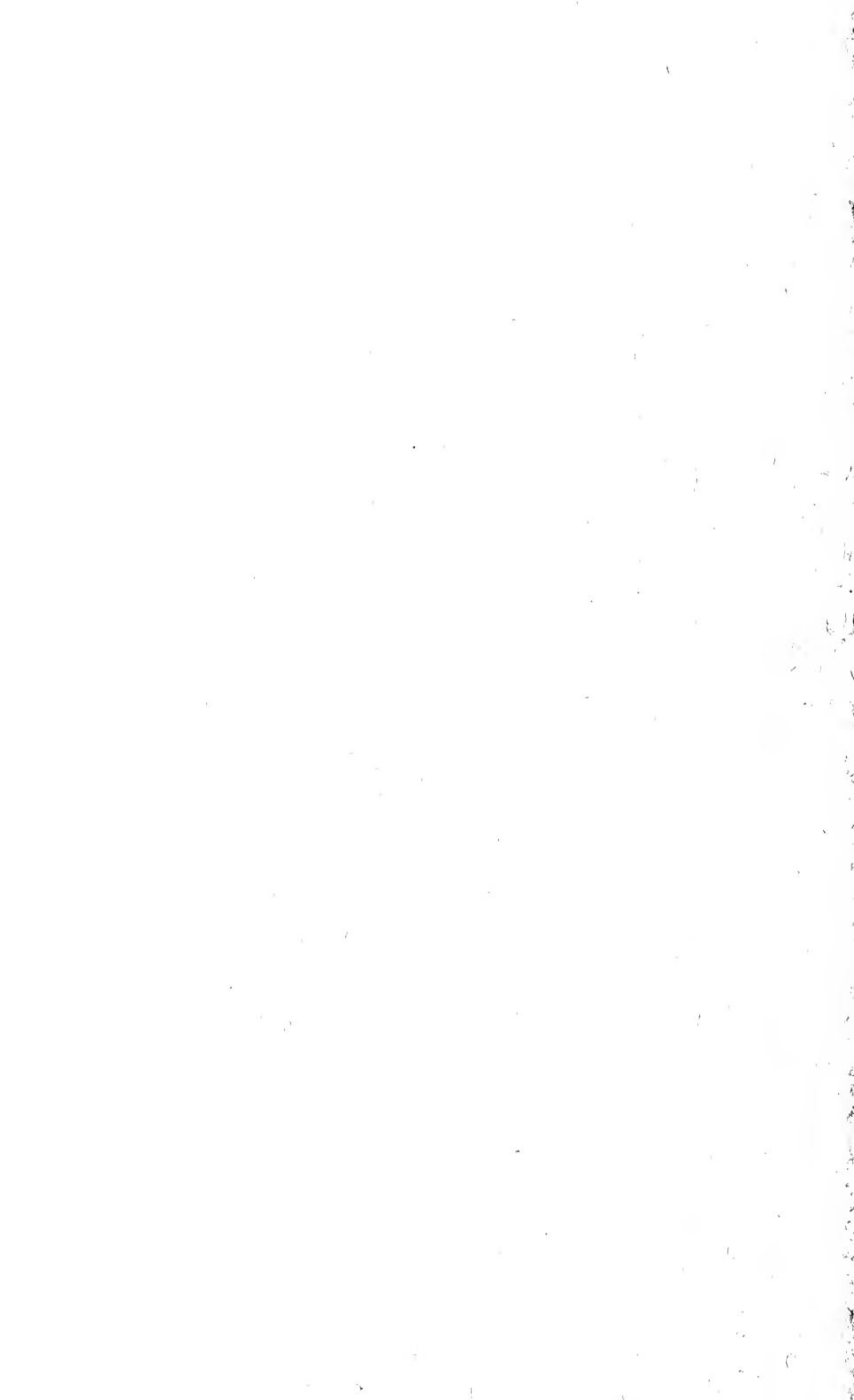
S. H. PERRY

Associate in Mineralogy
U. S. National Museum



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(WITH FIVE PLATES)

On September 24, 1944, two Japanese men, Yoshio Nishimoto and Akio Ujihara, temporarily stationed at the Topaz Relocation Center, Utah, were prospecting for rocks suitable for their class in lapidary arts. The area under investigation was about 16 miles west of Topaz in the Drum Mountains (latitude $39^{\circ}30'$ N., longitude $112^{\circ}54'$ W.). This district had been prospected several times with varying degrees of success, but fortunately these men were unusually persistent. Their trail happened to pass near a large rock protruding above ground about 2 feet. They noticed that it had a different appearance from other rocks scattered about; it was dark brown in color and had holes in it; it would "not chip with a hammer." As a result the men suspected that they had found something out of the ordinary, and Mr. Nishimoto sent a specimen of the rock to the Smithsonian Institution, with a letter of explanation describing the find.

The specimen was small and very much battered, but the description and sketch of the mass that accompanied it indicated clearly that a new and large meteorite had very likely been found. Tests made on the sample furnished proved that it was an octahedral meteorite. A quick search of our records failed to show any known fall from near Topaz, Utah; hence the specimen at once became of particular interest to us. The U. S. Geological Survey was asked to furnish a trained geologist to make a field investigation. They kindly consented and detailed Arthur E. Granger, then stationed in their Salt Lake City office, to make the study. The following is his report:

The meteorite and the area surrounding it were examined on October 8, 1944.

The specimen was found in an area of low hills lying between the Drum Mountains and the Little Drum Mountains. No section corners were found, but from other observations the location of the specimen was determined to be

in Township 15 South, Range 10 West and approximately Section 29, Millard County, Utah, and, according to authorities at the Topaz camp, on public domain.

The country rock is entirely basic or basaltic lavas and there was no evidence of a crater near the meteorite. The meteorite was not a recent fall, although it had undoubtedly remained on the surface since its fall and the area around it had been somewhat modified by erosion. From the amount of surface oxidation and relation of the specimen to the surrounding area I should guess that it fell within the last hundred years.

There was enough of this iron projecting above ground to make it conspicuous once attention was attracted to it, and the fact that when struck with a hammer it gave a clear-toned ring perhaps prompted the finders to make investigation as to its nature.

Shortly after Mr. Nishimoto received a letter from the National Museum identifying the specimen as a meteorite, it was moved from its resting place in the field to the Relocation Center, where it was displayed for several days prior to shipment to Washington. The moving of such a heavy object required the assistance of several companions at the camp as well as the use of equipment kindly lent by the camp authorities.

DESCRIPTION OF THE METEORITE

The Drum Mountains iron weighs 1,164 pounds (529 kg.) and has approximately the following dimensions: 2 feet long, 1.5 feet high, and from 1.5 to 2 feet wide. Its greatest perimeter is approximately 7 feet and its shortest about 5 feet. It is an irregular, rounded mass with few projecting points. The surface of the mass that was exposed above ground has been etched by wind-blown sand and dust. A delicate parallel grating of minor ridges, due to the unequal resistance to the dust abrasion of the different component alloys making up the meteorite, is a noteworthy feature of this iron. The surface is well covered with broad, shallow depressions popularly known as "thumb marks." However, there are other depressions that are deeper and that appear to have a different origin than these shallow thumb marks, which are assumed to have originated during flight. There are a number of these deeper depressions scattered over the surface on all sides of the meteorite. They are so irregular that accurate measurements of their size are difficult to make, but the relative dimensions of a number of them are given in table 1.

The interior of these deeper cavities is usually evenly rounded and rather smooth, with a surface texture slightly different from the rest of the meteorite. Perhaps this is entirely due to the lack of any abrasion by the wind-blown dust, or to the fact that on the protected

surfaces within the depression a slightly thicker film of oxide has accumulated. The side walls of these depressions are in most cases spherical in form, and frequently the openings have less of a diameter than the width of the cavity when measured about halfway down toward the bottom.

That portion of the Drum Mountains specimen that was buried in the ground has a very different appearance from the rest of the meteorite. The oxide coating is more scaly and appears about like the rust on a weathered artificial iron. The oxide coating over the

TABLE 1.—*Approximate dimensions of the cavities in Drum Mountains meteorite*

Diameter <i>Inches</i>	Depth <i>Inches</i>	Diameter/depth
1.25	1.5	0.83
1.0	1.25	0.8
1.0	0.5	2.00
1.25	0.75	1.66
1.25	1.00	1.25
1.0	1.5	0.66
2.5	2.0	1.25
1.25	0.75	1.66
1.0	1.5	0.66

rest of the meteorite is firm, rather smooth, and does not appear to have been so intensively weathered as that on the bottom of the specimen, perhaps because there the wind-blown material has cut much of the oxide film away. The shallow depressions or "thumb marks" so characteristic of the upper surface of this specimen are less conspicuous on the under side.

One large cavity which has a sharp rim around its opening was found to contain many layers of concentric iron-oxide scales; in fact this depression was almost entirely filled with scales when the meteorite was received. This cavity was so located on the specimen, as it stood in the field, that it would not have accumulated water from surface rains. Any moisture that did enter would do so by condensation or by capillary creep, against the metal. It appears that this depression was being deepened and enlarged by corrosion from moisture condensed within it. These concentric scales of iron oxide cut across the internal structure of the meteorite making a rosette of scales. (See pl. 1, fig. 2.)

Unfortunately, the scales from this cavity were cleaned out and mixed into one sample. It would have been desirable to have made some tests upon the composition of the various layers to see how the

nickel content differed. The following quotation from J. S. March, "Alloys of Iron and Nickel," p. 512, seems worthy of repeating:

In 1916 Stead¹ reported that the scales of nickel steels consist of several layers and that the nickel content of the layers differed widely. For example the outermost layer of scale on a 25% nickel steel consisted mainly of iron oxide, whereas the innermost layer included particles of metal containing 76% nickel. These findings were amply verified by Pfiel² who found the scale on iron and steel to consist of three layers, on a 2.75% nickel steel the outermost layer of scales contained no nickel, the middle layer 0.16% and the innermost layer 7.07%.

March further states (p. 511):

Once a continuous film is formed further oxidation must proceed by diffusion of oxygen through the oxide layer. Cracking and peeling of films in service are often to be ascribed to bending or cycles of heating and cooling. But the absence of such stresses, cracking may result when the metal surface is converted to oxide, volume changes leave the film in a state of compression, and it can be shown that these stresses result in cracking when the thickness of the film exceeds a limiting value.

This explanation seems to account for the structure shown by the scales in this cavity.

The surface appearance of these scales resembles that of the bottom of the meteorite. Any water falling on the exposed surface would drain off easily, and that accumulating in the upturned depression would rather rapidly evaporate. Moisture evaporating from the ground would condense and be retained on the under surface of the specimen or in an inverted depression; hence these parts have been exposed to many more hours of hydrous alteration. Some of these deep holes did not show any excessive accumulation of iron oxide. There is one cavity in the large piece removed for sectioning which extended through three of the slices. The iron oxide that had formed around the surface of this hole was not of equal thickness all around the cavity. This oxide also cuts across the internal pattern of the meteorite.

The 22-pound specimen removed for sectioning was found to contain few small troilite inclusions; hence we do not attribute these deep holes to the burning out or weathering out of troilite. The depth of these depressions suggests that they may have been in existence prior to the time the meteorite entered our atmosphere.

A sample of scaly material was analyzed. Several other pieces of scale were polished and found to contain small inclusions of metallic iron.

¹ J. E. Stead, *Journ. Iron and Steel Inst.*, vol. 94, pp. 243-248, 1916.

² L. B. Pfiel, *Journ. Iron and Steel Inst.*, vol. 119, pp. 501-560, 1929.

CHEMICAL COMPOSITION OF DRUM MOUNTAINS METEORITE

A slice about three-eighths of an inch thick was polished and etched to develop the structure of the iron and reveal any inclusions. The sample used in the analysis was selected by cutting out all inclusions or unusual structural features so as to obtain a characteristic sample of the meteorite.

TABLE 2.—*Composition of Drum Mountains meteorite*

E. P. Henderson, analyst

	Fresh meteorite	Oxide scales
Fe	90.70	Not determined
Ni	8.50	5.42
Co	0.58	0.51
P	trace	Not determined
S	none	Not determined
Insol	0.01	Not determined
H ₂ O .....	.....	5.26
	99.88	

Sp.g., 7.857.

$$\text{Mol. ratio} = \frac{\text{Fe}}{\text{Ni} + \text{Co}} = 10.47.$$

The Drum Mountains iron is a medium octahedrite, with bands averaging about 1 mm. in width but with occasional wider or narrower bands. The octahedral structure is highly developed, though somewhat irregular.

Taenite is abundant, with many thickened or wedge-shaped lamellae having darkened cores due to incomplete transformation. A number of Reichenbach lamellae up to 2 or 3 cm. in length are noticeable. A few nodular troilite inclusions were observed and also a number of small irregular inclusions. Schreibersite appears in irregular bodies of various shapes, some of considerable size, but no rhabdites or fine phosphide particles were observed. Although the analysis shows no sulfur and only traces of phosphorus, the sample chosen for analysis being carefully selected to avoid them, both troilite and schreibersite are fairly abundant in the meteorites.

Plessite fields are numerous and show a great variety of structure. Some very light fields are composed of a reticulated pattern of kamacite grains with droplets of taenite along grain boundaries. In some fields the scattered taenite particles are imperfectly spheroidized. In contrast with these "light" types are many "dense" fields composed

of an imperfectly transformed gamma-alpha mixture, appearing black and unresolved except at high magnifications, the dark interiors often being traversed or even filled with oriented lamellae of kamacite.

At the edge of one slice a zone of heat alteration was observed, the normal structure being obliterated by secondary granulation.

This meteorite must have struck the earth with considerable force, but neither the surrounding area nor the specimen itself showed any indication of where or how this energy was dissipated. The problem of how much kinetic energy this mass would have had as it struck the earth, assuming the meteorite as falling from a height of 10 miles and starting with 0 velocity, was presented to L. B. Aldrich, Director of the Smithsonian Astrophysical Observatory. His reply is as follows:

The magnitude of the air resistance in the fall of your meteorite from 10 miles up is very uncertain. If we assume no air resistance, the 10-mile fall would take 57 seconds and its velocity on reaching the earth would be 1,840 feet per second. Its kinetic energy would be 61 million foot-pounds, or 84 million joules. These are computed from the well-known formulae:

$$V = V_0 + at$$

$$S = V_0t + \frac{1}{2}at^2$$

$$\text{Kinetic Energy} = \frac{1}{2} MV^2$$

where V = velocity, t = time, s = distance, M = mass, and a = acceleration due to gravity.

Actually, of course, the kinetic energy on reaching the earth would be appreciably less because of air resistance. A. F. Zahm some years ago, using 4-inch spheres as projectiles, experimentally determined air resistances for velocities up to 1,000 feet per second. Applying his values to the meteorite I compute that it would take approximately 70 seconds to fall and its kinetic energy would be about 18 million foot-pounds.

Two uncertain factors enter, however: (1) Air at 10 miles altitude is much less dense than lower down. Thus the computed value is too small. (2) The meteorite is not a sphere, but a rough, irregular mass. This would make the computed K.E. too much. My guess is that the meteorite's K.E. would be perhaps in the order of 20 million foot-pounds.

We know the meteorite started much higher than 10 miles up and that it had an initial velocity much greater than zero assumed for this problem. However, before the mass hit the earth it had attained its maximum velocity and in fact must have been slightly retarded. Yet when this 1,164-pound iron was found it was resting almost entirely on the surface of the ground. True, it may have come to rest after striking elsewhere, but no crater was found in that vicinity.

There is only one place where the meteorite exhibits any distorted metal that may mark the place on the sample which came in contact with the ground at the moment of impact. One would certainly think

that a meteorite of this weight falling upon hard rock would be conspicuously scarred, but it is not so in this case. There is always the possibility that it fell at a place where there was considerable accumulation of sand or soil and perhaps the ground at that point may also have been further protected by a rather deep snowdrift.

The Drum Mountains iron is the eighth largest individual meteorite reported from within the United States. The following table lists the individuals preserved in collections which exceed the Drum Mountains in weight.

List of individual meteorites from the United States which exceed Drum Mountains in weight

Name	State of origin	Weight Kg.
Willamette	Oregon	14,175
Navajo	Arizona	1,503
Quinn Canyon	Nevada	1,450
Goose Lake	California	1,167
Sardis *	Georgia	800
Red River	Texas	743
Tucson	Arizona	688
Drum Mountains *	Utah	529

* All weights except these were taken from Frederick C. Leonard and Dorothy H. Alley's listing in *Pop. Astron.*, vol. 55, No. 9, pp. 497-502, 1947.

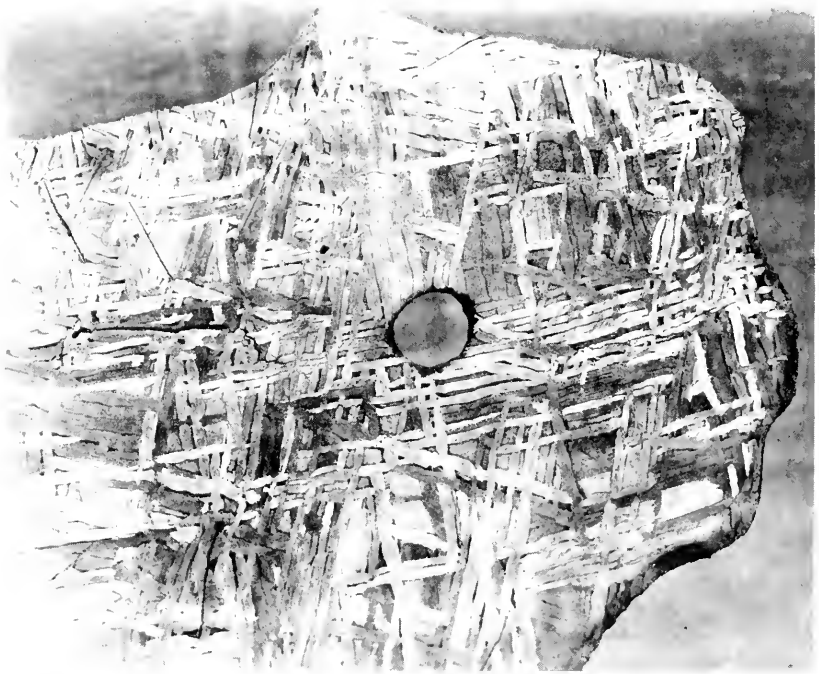
This 22-pound portion of Drum Mountains meteorite was sectioned into 10 slices. This cutting was done on an endless band saw using a 1¼-inch band of soft iron (18-gage) onto which the carborundum is washed with a small stream of water. The two wheels of this saw are 36 inches in diameter and make 100 revolutions per minute. The cutting band is traveling at the rate of 941.6 feet per minute. Mr. Reberholt in charge of the Mineralogy Laboratory of the Museum made a record of the time required to cut all the slices and the quantity of the carborundum used. The 10 slices required 201 hours of cutting time and \$61.60 worth of carborundum. These figures may be of some interest to those who wish to know something about the cutting costs of an iron meteorite. The figures are basic, so by multiplying the cutting time by a wage that such an operator would receive, adding a factor for power, depreciation of machinery, final polishing, etching, etc., it becomes clear why large slices of meteoritic iron are very expensive specimens.



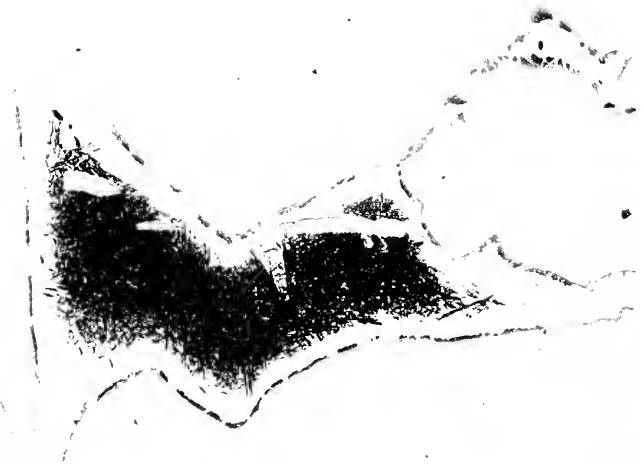
1. GENERAL VIEW OF THE DRUM MOUNTAINS METEORITE IN PLACE



2. A CAVITY WITH CONCENTRIC LAYERS OF WEATHERED OOLITE



1. Octahedrite. The black veins are fractures filled with what is believed to be fused oxide forced into the fractures during flight. The hole is a deep surface depression with weathered oxide irregularly distributed around the rim. About $\frac{1}{2}$ natural size.



2. An irregular body of taenite with a core of dense untransformed gamma-alpha aggregate showing an acicular structure with some orientation. The taenite outside of the dark core is mostly clear and fully transformed, but where it adjoins the surrounding kamacite it is gray at many points because of supersaturation with respect to kamacite. The taenite area encloses short needles (lamellae) of kamacite, and (at right) a large body of kamacite. Pical 30 seconds $\times 65$.



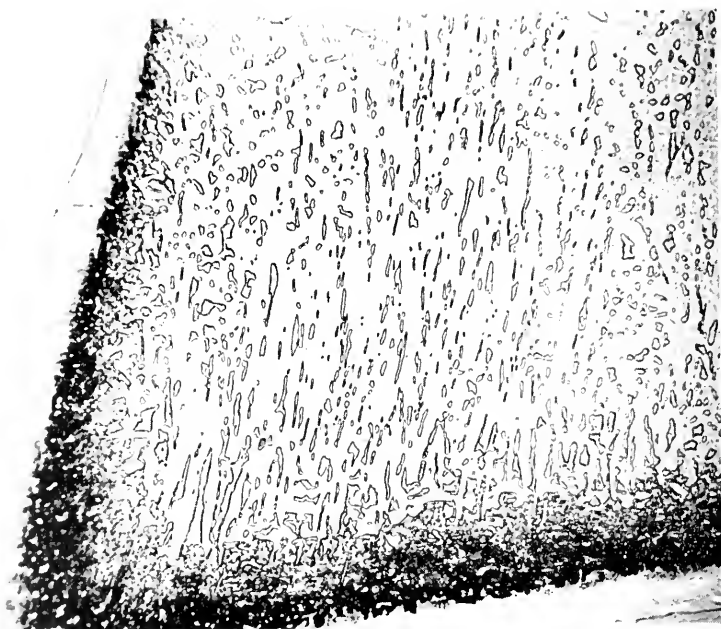
FIG. 1.—A plagioclase field filled with oriented needles characteristic of *Kilbourneite*. In the upper portion they appear in a ground mass of dense, micro-solved *actinolite* and *epidote*; in the lower portion they are in clear, fully transformed *taconite*. (Photomicrograph.)



FIG. 2.—A field of plagioclase with disjunctive forms characteristic of *actinolite*. In the upper portion they are in a ground mass of *actinolite* and *epidote* (by *actinolite*); in the lower portion they are in clear, fully transformed *taconite*; the latter may be *actinolite*. (Photomicrograph.)



2. An area along the inner border of a zone of alteration at edge of slice. The alteration is apparent along the right-hand side of the photograph. A kamacite band is partly altered, its right-hand boundary having disappeared in the secondary granulation produced by heating during flight through the air. Pictal 120 sec.



1. Part of a field of plesite composed of elongated and oriented particles of fully transformed taenite in kamacite, surrounded by a border of clear taenite. Inside the border there is a zone of imperfectly transformed gamma-alpha aggregate. Pictal 40 seconds. $\times 95$.



10. A fold of light pleistite consisting of granular inclusions with thin needles of taenite along the grain boundaries (hardly visible in this view). The matrix is sparse, largely continuous at the edge of the fold, and most of the surface only traces of grayness even with strong etching. One small hole is visible. Porosity 40 minutes $\times 35$.



11. An irregular lamella of taenite. The irregularities suggest deformation in place. Its displacement suggests that it is not still possessing considerably plasticity. At least 100 minutes $\times 35$.





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VOLUME 110, NUMBER 13
(END OF VOLUME)

CONTRIBUTIONS
TO THE ANTHROPOLOGY OF
THE SOVIET UNION

(WITH FIVE PLATES)

COMPILED BY
HENRY FIELD



(PUBLICATION 3947)

CITY OF WASHINGTON
PUBLISHED BY THE SMITHSONIAN INSTITUTION
DECEMBER 22, 1948

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PREFACE

This study, which includes a compilation of anthropological data based on Soviet published and unpublished materials, has been divided into two sections, one dealing with archeology, the other with physical anthropology.

The majority of the archeological publications from which summaries have been translated were given to me while a guest of the Academy of Sciences of the U.S.S.R. during June July, 1945, in Moscow and Leningrad. The occasion was the Jubilee Session celebrating the 220th anniversary of the founding of the Academy by Peter the Great.

I was the bearer of official greetings from the Smithsonian Institution, the Archaeological Institute of America, the American Anthropological Association, the Library of Congress, the National Archives, and the National Geographic Society. At a full session of the Presidium of the Academy of Sciences in Moscow I was invited to address the Academy and to present these greetings from the United States, which were officially accepted and warmly reciprocated by President Vladimir Komarov. For an account of this trip the reader is referred to "Anthropology in the Soviet Union, 1945" in the *American Anthropologist*, vol. 48, No. 3, pp. 375-396, 1946.

Chapter III was translated by Mrs. John F. Normano, the Asia Institute, New York City. Chapters IV and V are based on summaries translated by Eugene V. Prostov prior to 1941. Some sections in chapter IV have been translated from French summaries during 1946 by Mrs. David Huxley, to whom a footnote reference is given. A special introduction to chapter IV, with a list of abbreviations (pp. 114-115), has been included.

While every effort has been made to express clearly and concisely the results obtained by the Soviet archeologists and anthropologists whose work has been translated and summarized, this has proved to be an exceptionally difficult task.

Among other special problems was the fact that work was begun on this publication 10 years ago and during the war years remained untouched. In addition, my collaborator, Eugene V. Prostov, has been on Government service abroad since 1946. However, he has checked the text, particularly the spellings of proper names, but without his customary library and reference works at hand. Hence, some discrepancies and inconsistencies, will appear. Dr. Sergei

Yakobson, Consultant in the Library of Congress, very kindly standardized some of the spellings in order to follow the Library of Congress system of Russian transliteration. Some place names follow the spelling approved by the Board on Geographical Names. We noted, but could not correct or change, differences in terminology: we have kept as close to the original as possible. In some cases we have made minor additions to elucidate the text either in footnotes with initials or in brackets.

Since we have often taken considerable editorial license with the text in the selection and rearrangement of the materials, we decided to place the name of the author in the first footnote of each article. On the other hand, there should never be any question as to the authorship of any statement.

This publication should be considered as complementary to our previous publications on the U.S.S.R. (see chapter IV, footnotes 1, 2), to my "Contributions to the Anthropology of Iran," and in particular to my forthcoming "Contributions to the Anthropology of the Caucasus," wherein will appear my anthropometric data on the North Osetes and Yezidis as well as Soviet comparative data on Ciscaucasia and Transcaucasia.

No bibliography has been compiled because, for the sake of convenience, references have been listed in the footnotes.

In the preparation of this material for publication, I have had some editorial assistance from Miss Morelza Morrow. As already mentioned, Mrs. John F. Normano and Mrs. David Huxley translated part of the material. The greater part of the text was typed by Miss Elizabeth Beverly in Thomasville, Ga. Miss Betsy King Ross, who very kindly assisted in the final stages of preparation, also typed part of the manuscript. We wish to acknowledge with gratitude all this assistance. We also wish to thank Dr. T. Dale Stewart, curator of physical anthropology of the United States National Museum, for making helpful suggestions regarding certain portions of the manuscript. My wife generously assisted in the compilation of the statistical tables and in proofreading the copy.

We are grateful to Soviet anthropologists, who have contributed so much to our knowledge of ancient and modern man from the Ukraine to Siberia and from the Far North to Central Asia.

We received information in 1939 and in 1945 that anthropometric surveys were in progress in European Russia, in the Caucasus, Turkestan, Central Asia, and Siberia, and hope that at some not too distant date we may be able to make the new results available to the

student of Asiatic racial problems, who is either unfamiliar with the Russian language or does not have access to this important Soviet literature.

HENRY FIELD

October 28, 1946.

Cuernavaca, Mexico.

CONTRIBUTIONS TO THE ANTHROPOLOGY OF THE SOVIET UNION

COMPILED BY HENRY FIELD

(WITH FIVE PLATES)

I. ALL-UNION CONFERENCE ON ARCHEOLOGY¹

This Conference, called by the Academy of Sciences, was held in Moscow during 1945. Represented at the Conference by a total of 156 delegates were the Marr Institute, the Academies of Sciences of the various Union Republics, branches of the U.S.S.R. Academy of Sciences, Peoples Commissariats of Education of the Union and Autonomous Republics, universities, teachers' colleges, central, territorial, regional, and municipal museums, the Commission on the Preservation of Ancient Monuments, and other scientific bodies.

The Conference was opened by V. Volgin, Vice President of the Academy of Sciences and chairman of the committee on organization. In his opening speech Academician Volgin reminded the delegates that the Marr Institute—the leading center of Soviet archeology—had recently celebrated its twentieth anniversary. Founded as the Russian Academy of the History of Material Culture, it succeeded the Committee on Archeology which had been in existence since 1859.

"We no longer support the teachings of former archeologists that the ancient history of our country was represented by separate 'archeological civilizations.' We regard it rather as a harmonious and logically connected chain of consecutive stages in the development of humanity from the Stone Age to the Middle Ages."

The problem of the origin of the Slavs and their relations with neighboring tribes is now presented from a new angle. Archeologists have traced the first stages in the formation of the Slavonic tribes to the beginning of our era. Scientists of today base their conclusions on material found in strata dating back to the Bronze Age and Neolithic civilizations. More and more light is being shed upon the unification of the Slavonic tribes in the first thousand years of our

¹ From VOKS Bulletin, 1946. This has been condensed and cited to conform to our style. (H. F.)

era, a factor which exerted a tremendous influence upon the history of Eastern and Central Europe.

Academician B. Grekov delivered a report on the achievements of archeological investigations in the U.S.S.R. He pointed out that interest in ancient cultural remains has long existed in Russia. As early as 1804 a scientific society called the Society of History and Russian Antiquities was founded in Moscow. As stated at the time, this Society was interested, among other things, in collecting antiquities, medals, coins, and other objects shedding light on various events in Russian history.

Pre-Revolutionary archeologists excavated much material connected with the ancient history of the peoples of Russia. The remains of Hellenic civilization in the northern regions of the Black Sea coast, objects excavated from Scythian burial mounds, and other materials cleared up many previously unexplored periods of Russian history. It was mostly due to the efforts of archeologists that a new field of study was opened to historians—the study of the Scythians who inhabited the territory of the present U.S.S.R. before the Slavs. Parallel with these investigations, archeologists unearthed the monuments of ancient Slavs in the Caucasus and Siberia.

In order to clarify previous observations and conclusions, the archeologists established firm ties with paleoanthropology, paleozoology, geology, soil science, philology, and history. At the present time archeology no longer stands apart from the general aims of history, but is itself a historical science solving the same problems and pursuing the same aims in its own specific field.

In recent years the number of sites investigated by archeologists has greatly increased. At the present time there is not a single region or nationality in the U.S.S.R. which has not been the object of study.

Significant achievements have been made in the study of the Stone Age. Hundreds of Paleolithic sites have been discovered and investigated, including those at Kostenki-Borshevo, Gagarino, Timonovka, and Malta and Buret in Siberia. Parallel with these studies, archeologists have charted the various periods in the Russian Paleolithic age, establishing the characteristics of its three main provinces—Asia, Europe Proper, and the regions of the Caspian Sea. These discoveries contributed much that was new to the existing conception of forms of Paleolithic tools and implements and of the art and mode of life of the people of that period.

Thorough investigations of a number of regions (the central part of European Russia, the Karelian-Finnish S.S.R., the Urals, and the Baikal area) made it possible to distinguish between the various

Neolithic civilizations and determine their chronological sequence. The new discoveries made in the course of these investigations, particularly the rock drawings in Karelia, the Gorbunovo turf pit, the Olen-Ostrov burial mound, and others, shed light on the religious conceptions of the Neolithic period, an aspect heretofore little studied.

Extensive investigations of the early Bronze Age have also been made. Excavations along the Dniester and the southern part of the Bug Rivers and at Usatovo near Odessa demonstrated the existence of various stages in the development of Tripolje culture and proved its prevalence in the whole Dnieper and Danube basin during the period from 3000-1000 B.C. Distinctions were established between the Bronze Age cultures in the northern and southern Caucasus, the Shengavit and Angbek cultures attributed to the early Bronze Age, the Kuban burial mounds and Eilar and the excavations at Trialeti,² all of which contained remains of highly developed Bronze Age cultures. Excavations at Urartu brought to light considerable material on the history of ancient Armenia. Investigations carried out in the Black Sea regions and in the Ukraine established the chronology of three main cultures—those characterized by pit, catacomb, and hut dwellings. The origin of each of these three types was clearly defined, and investigations were made of settlements of this period for the first time. It was established that the final stage in the development of Bronze Age culture was that of the Cimmerians, who inhabited this region previous to the coming of the Scythians. In the Volga region investigations established the existence of two cultures—that of Poltava (the beginning of the Bronze Age) and of Khvalinsk (the end of the Bronze Age). Investigations in Siberia established three stages of the Bronze Age as represented in the Manasiev, Andronovo, and Karasuk cultures. A new culture—the Abashev—was discovered in the Chuvash Republic and adjacent regions.

The study of the Scytho-Sarmatian culture is of great significance for a knowledge of the population in the pre-Slavonic era and for determining the ethnogeny of Slavonic tribes. New excavations were carried out on the ancient sites of Kamensk, Sharapovsk, and Nemirov, as well as on the right bank of the Bug River and the western coast of the Black Sea. Excavations were also made of Scytho-Sarmatian burial mounds in the Kuban, the southern regions of the Dnieper, and in other localities.

Soviet archeologists continued the excavations begun in the ancient

² See Kufnin, B. A., and Field, Henry, Prehistoric culture sequence in Transcaucasia, *Southwestern Journ. Anthropol.*, vol. 2, No. 3, pp. 310-350, 1946, and Microfilm No. 2310, pp. 1-126, in American Documentation Institute.

cities of the Black Sea region—Olbia,³ Chersonesus, Phanagoria, and Kharabs [Charax?]. Excavations were also begun at other sites.

A more profound comprehension of the Scythian problem, as Academician Grekov pointed out, prepared the ground for a revision of views concerning the origin of the Slavs, particularly of the eastern branch. New investigations have confirmed the ethnogenetic chart outlined by Academician Nikolai Marr confirming the local origin of the eastern Slavs whose roots go back to the tribes of the Tripolje culture, to the Bronze Age civilization in the steppe regions, to the Scythians, and finally to the epoch of field burials. Agricultural tribes of Scythians along the middle course of the Dnieper as well as tribes from the upper reaches of the Dnieper, whose culture has been studied only in the past few years, are now accepted as component factors of the Slavonic ethnogeny.

One of the most important subjects of archeological research has been that of the Antae and their culture. Investigations of this problem can confirm the existence of definite connections between Antean culture and that of the preceding burial-field stage of culture and can also show the more original nature of Antean culture and its higher stage of development. Evidence pointing to this is found in their field agriculture, livestock breeding, skilled arts and crafts, and large settlements of an urban type. Beyond question the center of Antean culture lay in the middle reaches of the Dnieper, in the regions later inhabited by the Polians. Grekov considers it to be an established fact that the culture of Kiev Russ is a successor of Antean culture.

In this connection Academician Grekov dwelt on the researches of Soviet archeologists concerning Russian culture and in particular ancient Russian cities. The first stage in these researches was devoted to revealing the prehistory of these cities, going far back into the pre-feudal period. The most important of these ancient cities were those which preceded modern Kiev, the settlements of the eighth and ninth centuries on the ancient site of Riurik near Novgorod, the cultural strata of the fifth and sixth centuries underlying the Pskov Kremlin, and the ancient strata of Staraja Ladoga dating back to the seventh and eighth centuries.

Taken in conjunction with the collections obtained by pre-Revolutionary expeditions, the many handicraft objects found in recent excavations enable archeologists to have a detailed picture of the evolution of urban crafts, their connection with and influence upon rural crafts, the progress and differentiation of technical methods,

³ See Minns, Ellis H., *Thirty years of work at Olbia*, *Journ. Hellenic Studies*, vol. 45, pp. 109-112, 1945.

and the labor skills involved in each particular craft. A study of the cast forms, for example, and of craftsmen's marks, throws light on the social position of the latter, their organizations, and similar matters.

Materials relating to various periods of the Bronze Age have been unearthed at Shengavit settlement, at Shresh-Blur, and in Eilar. Particular interest attaches to the findings made by the expedition of the Georgian Academy of Sciences in the Trialeti burial mounds. Excavations of a tomb near Mtskheta, just north of Tbilisi [formerly Tiflis], furnished valuable material relating to the ancient Georgian kingdom. New finds, which shed light on the later Urartu epoch, have been unearthed on the hill of Kamir-Blur by expeditions of the Armenian Academy of Sciences. Extensive research has been carried on in Azerbaidzhan concerning cyclopean edifices. Investigations of medieval cities in Armenia and Georgia have been launched on a large scale. All these and many other excavations have produced material on the ancient history of the peoples inhabiting the Caucasus and Transcaucasia and their relations with ancient eastern states.

Excavations in Central Asia have unearthed Kelte-Minar and later Tazabagiab cultures which indicate historical connections between the population of ancient Khwarazm (Khoresm) and the north (the Afanasiev and Andronovo cultures), and the east (the Anau culture). Expeditions in Shakhrasiab, Urgench, and Khwarazm, and the excavations of ancient Taraz, all of which unearthed material on a later period in the history of Central Asia, have proved the existence of cultural relations between the ancient population of Central Asia and the Near East.

Prior to 25 years ago only 3 Paleolithic sites were known in Siberia, whereas more than 60 are known today. This has made it possible to establish the various periods in Siberian Paleolithic cultures, and of Neolithic settlements in the lower reaches of the Amur, on the shores of Lake Baikal, on the Angara, the Yenisei, and the Ilim Rivers. A study of the Bronze Age established the first appearance of livestock breeding, agriculture, and the smelting of metal. Three stages of Siberian Bronze Age culture have been established—the Afanasiev, the Andronovo, and the Karasuk. The dissemination of northern Chinese bronze as far west as the present cities of Molotov and Gorki raises the question of the role of cultural relations with the Far East as well as with the Near East, in forming a cultural unity among the peoples inhabiting the territory of the U.S.S.R. in ancient times. Remains corresponding to Scytho-Sarmatian culture in the southern regions of European Russia have been discovered in Siberia.

In archeological research concerning the peoples of the Volga and

Ural regions, particular attention has been paid to the so-called Ananino culture, which is a connecting link between the Bronze Age and the formation of now existing nationalities of these districts. During the Soviet period large-scale investigations have been begun to elucidate the early history of the Udmurts, the Komis, the Bashkirs, and the Mordovian tribes.

Special attention has been given to a study of the Bulgar and Khazar cultures. It is now possible to reconstruct a picture of the life in the Bulgar cities of the Volga region (Bulgari, Suvara, and others) both in ancient times and in the period of the Golden Horde. A systematic study of the material relating to the Khazars has made it possible to elucidate a number of obscure aspects of Russian-Khazar relations in the history of the Slavonic-Russian colonization of the southeast.

Without the efforts of archeologists the early pages of the history of the Bulgars, the Khazars, the eastern Slavs, and the even earlier Scythian and Greek colonies on the north coast of the Black Sea, and of ancient Armenia and Georgia would still remain unknown.

Academician Meshchaninov delivered a report on the planning of archeological expeditions in the U.S.S.R. Many of the archeological investigations, both theoretical and field researches outlined for the 1945-1949 period, are closely linked with key problems concerning the history of Soviet peoples which have been singled out for attention in the last few years. In most cases plans for large-scale excavations provide for the cooperation of several scientific institutes.

The plan also provides for systematic researches covering several years and extensive regions. In liberated cities where reconstruction will be carried out on a large scale, appropriate archeological work is being planned as well as measures for preserving the most important monuments of the past.

One of the tasks confronting Soviet archeologists is that of restoring the collections of many of the museums plundered by the Nazis and the restoration of many treasures of Soviet art and architecture damaged during the German occupation.

Academician Grabar made a report on new legislation concerning the preservation and study of archeological monuments.

II. RECENT WORK IN ANTHROPOLOGY¹

A. ANCIENT PEOPLES AND THEIR ORIGIN

The discovery of the fossil skeleton of a child in Teshik-Tash cave in the mountains of Central Asia represents one of the most important anthropological finds of recent years.

Southern Bukhara lies in the Hissar Mountains. Teshik-Tash grotto is located in the Zautolos-Sai Canyon of the Beissen-Tad Mountains, belonging to the Hissar Range. This grotto (7 x 20 x 7 m.) stands at an altitude of 1,600 m. above sea level. The central area of the grotto represents a fossil-bearing layer containing animal bones, worked stone, and carbonized materials superimposed on a porous layer of clay. Underneath the clay lies another fossiliferous stratum. Altogether there are five strata with a total thickness of about 1.5 m., of which 40 cm. contain fossils.

In 1938 A. P. Okladnikov discovered the remains of a human skeleton² at the base of the first layer at a depth of 25.0 cm. The skull lay in a depression in the non-fossil-bearing layer. The horns of mountain goats arranged in pairs were found in the immediate vicinity. Heaps of charcoal and the remains of fires were found in several places in the fossiliferous stratum. Okladnikov concludes that ritual burials took place here. The alternation of fossiliferous and sterile strata indicates beyond doubt that Teshik-Tash was not permanently inhabited. However, it is evident from the thickness of the non-fossil-bearing strata that the intervals between the use of the grotto were very long.

The geological study of the canyon and grotto yields little for the determination of the epoch to which the fossil-bearing strata of Teshik-Tash belong, but in any case there is nothing to preclude the supposition that they belong to the Pleistocene period.

¹ This chapter, by V. V. Bunak, of the Research Institute for Anthropology, University of Moscow, has been edited to conform to our style. Some passages have been condensed; some footnotes have been added. This article appeared in *VOKS Bulletin*, Moscow, Nos. 9-10, pp. 22-29, 1945. See also Franz Weidenreich, *The Paleolithic child from the Teshik-Tash cave in southern Uzbekistan (Central Asia)*, *Amer. Journ. Phys. Anthrop.*, n.s., vol. 3, No. 2, pp. 151-163, 1945, and Henry Field, *Anthropology in the Soviet Union*, 1945, *Amer. Anthrop.*, vol. 48, No. 3, pp. 375-376, July-September, 1946.

² For illustrations of the Teshik-Tash skulls and reconstructions by M. M. Gerasimov, see *Amer. Journ. Phys. Anthrop.*, n.s., vol. 4, No. 1, pp. 121-123, 1946.

The fossil-bearing strata contain many fragments of bones. According to V. I. Gromov, the following types of mammals are represented: Siberian goat (*Capra sibirica*), horse (*Equus caballus*), wild boar (*Sus scrofa*), leopard (*Felis pardus*), marmot (*Marmotta* sp.). The remains of mountain goats are the most numerous. In general, the composition of the fauna is similar to that of the present day. According to Gromov's supposition, orographic, climatic, and faunal conditions in this part of Central Asia have changed little since the end of the Pleistocene period.

Stone implements were mainly of local siliceous limestone; some were of quartz or quartzite. One implement was made of limestone. The first fossil-bearing stratum contains many so-called "cores," most notable of which are long, massive, oval implements with broad sides and thick round ends fashioned by chipping with a sharp instrument. Flatter scrapers of various forms and sharp-pointed tools of primitive type have also been discovered. Chips and flat pieces of stone for making implements are in abundance. There is a complete absence of objects made of bone and horn. According to Okladnikov Teshik-Tash stone technology corresponds to Mousterian culture in Europe. He also notes the similarity between the typology of Teshik-Tash and the Middle Paleolithic of Palestine and southern Kurdistan in Iraq.

The remains of the human skeleton were brought to the Anthropological Museum of the Moscow State University. Part of the femur, the tibia, the humerus, and both clavicles were in a fair state of preservation. The skull was smashed into more than 150 fragments, but all of them were well preserved and it was possible to restore almost completely the cranium and face. This reconstruction³ was made by the sculptor and anthropologist, M. M. Gerasimov. Research on the skeleton was conducted by G. F. Debets, M. Gremiatskii (the skull), N. A. Sinelnikov (bones of skeleton), V. V. Bunak (endocranial cast), and others. The results of this work are set forth in a comprehensive monograph now in press.

The preliminary examination revealed that the Teshik-Tash skeleton was that of an 8- or 9-year-old child, probably a boy.

The cranial capacity is large, but the vault of the skull is comparatively low, with an angular occiput, prominent superciliary ridges, and massive bones. The chin is little developed. The teeth are large. The endocranial cast reveals, among others, the following characteristics: a sloping frontal region; a wide fissure between the lobes;

³ I had an opportunity to examine the skull and the reconstruction on June 16, 1945. (H. F.)

impressions of convolutions as far as the frontal protuberances; and a central frontal furrow with a horizontal posterior protuberance.

These characteristics do not identify the skeleton with any variation of modern man even at the lowest stage of his development, but relate the Teshik-Tash skull to the type of fossil man belonging to the end of the Pleistocene period, the Middle Paleolithic, or, broadly, "Neanderthaloid."

This conclusion is beyond doubt, but from the modern point of view it is insufficient. Middle Paleolithic includes many different human types, such as the typical European Neanderthal, fossil remains from Ngandong in Java and from various places in Africa and Palestine. The question arises as to which of these types the Teshik-Tash skeleton most resembles. The extreme youth of the Teshik-Tash cranium renders it difficult to draw a final conclusion, since there is insufficient comparative material for that age. Comparative research in new data, especially the Palestine discoveries, will probably render it possible to clear up this interesting question. Nevertheless, even now the Teshik-Tash discovery is of great interest. First of all, it greatly extends the area in which Middle Paleolithic man existed. All previously found human remains were discovered at comparatively short distances from the sea. The Teshik-Tash skeleton is the first reliable proof of the penetration of Middle Paleolithic man into the interior of the Asiatic continent. Proof that man lived in high mountainous regions is also of great importance. The Teshik-Tash skeleton provides valuable material for the investigation of the variations of the "Neanderthaloid" type and for the study of age peculiarities of ancient man.

A valuable monograph by G. A. Bonch-Osmolovskii entitled "The Hand of Paleolithic Man" was published in 1941 just before World War II. It treats of another most important find of fossil man—the skeleton of a hand found in the Kiik-Koba grotto in the Crimea. Considerable literature has been written about this discovery, but a comparative anthropological study of the skeleton, the skull of which is unfortunately missing, required many years of persevering work. The published monograph treats only of the bones of the hand and is a work of exceptional value as the author is the first to have collected exhaustive material about the structural peculiarities of this important part of the skeleton of modern man, fossil man, and of various groups of *Cercopithecus* monkeys.

As the result of measurements and reconstruction, Bonch-Osmolovskii notes the following peculiarities of the skeleton of the hand of the Kiik-Koba man: relative elongation of the fourth and fifth

fingers; very broad carpus, metacarpus, and phalanges, especially the extreme phalanges, which give the hand a peculiar, flattened form; the flatness of certain joints which extend more horizontally giving rise to the conclusion that the Kiik-Koba man was little able to bend his fingers palmward but better able to move them sidewise. The position of the thumb is most peculiar as the joint of the first metacarpal bone is very slightly developed. Bonch-Osmolovskii believes that the ability of this fossil man to move his thumb toward the palm was greatly restricted. The general impression gained is of a wide, flat, pawlike hand. The Kiik-Koba hand is the first to have been studied in such detail and so systematically, but Bonch-Osmolovskii concludes that many of the above-mentioned features are inherent to some degree in skeletons of the European Neanderthal man. At the same time, Bonch-Osmolovskii proves convincingly that the above-described structural type of hand is not similar to that of anthropoid apes but, on the contrary, has developed away from them in the opposite direction.

In general, the Kiik-Koba man had a human hand and could make various stone implements.

Regarding the pawlike hand as the original form in the evolution of man, partially repeated in the individual development of modern man, Bonch-Osmolovskii concludes primitive man's locomotion was not like that of modern anthropoid apes.

The latter are clearly a side branch. The distant ancestors of man were adapted to a different type of locomotion, were less specifically tree forms, and according to the structure of the hand were closer to the modern group of ground monkeys of the Pavian type. This conclusion is supported by interesting facts concerning the type of locomotion of the various Primates, the development of the grasping ability in a child, and other data.

Naturally, Bonch-Osmolovskii's conclusions cannot be regarded as proved beyond doubt, especially those giving general characteristics of the hand of fossil man. The necessary data for this are lacking. The problem of the relation between various forms of Middle Paleolithic man and the modern type remains unsolved. However, Bonch-Osmolovskii's hypothesis that anthropoid apes and their specific type of grasping hand are the result of a new branch developing in a definite direction within the species is shared by many modern authorities. It is quite possible that the hand structure of Miocene Primates (to which both human and anthropoid branches trace their origin) not only lacked the distinctive features of anthropoid apes but was closer to the modern semiground types of Primates. In

developing this view, Bonch-Osmolovskii contributed new material of outstanding importance for studying the evolution of man.

The wide dispersal of *Neanthropus* at the end of the Pleistocene period and the disappearance of the ancient form (*Paleoanthropus*) is testified to by many discoveries in various parts of the world. What were the factors which ensured the predominance of *Neanthropus*? This problem has been discussed in a number of works, some published and some still in press. The views developed by P. P. Efimenko deserve first mention here. In one of the chapters of his book, "Primitive Society," Efimenko observed during 1938 the significance of strict endogamy (intertribal marriage) which existed in the small hordes of the Mousterian epoch for the fixation of the specific features of the Neanderthal type. The appearance of the new type was conditioned by the formation of broader social groups, the beginnings of the gens organization. This view deserves attention although Efimenko treated the Neanderthal features in a very narrow manner, perceiving in them only signs of degeneration. Actually, it is not degeneration one should perceive but rather specialization.

S. P. Tolstov and A. Boriskovskii stress the great part played in the evolution of man by the development of hunting and technology in the Middle Paleolithic period. Indeed, collective hunting is a most important stimulus to the development of new forms of intercourse among humans, their uniting in large groups, the invention of call signals, the creation of new tools, the acquisition of new materials (horn and bone), and radical alterations in diet.

An interesting view was expressed by G. G. Roginskii, who noted that the small Neanderthal groups themselves presented obstacles to their further development. Unless he was restrained by social motives or self-control, the club-bearing and stone-armed Neanderthal man represented a considerable threat to his fellows in various conflicts for the female and for food.

The development of these two means of restraint are most typical of *Neanthropus*. They are closely connected with the development of the brain, especially the frontal region, the formation of which marks the last stage in the physical evolution of man.

A study of the endocranial casts of Neanderthal man stresses the importance of other elements of cranial structure. One of the most striking features of *Paleoanthropus* is the very slanting frontal region, the high temporal ridge resulting in the feeble development of the lower parietal region (i.e., the region with which conscious speech is connected). Considering that the general brain cavity of Neanderthal

man was no smaller than that of modern man, then Bunak's conclusion that a certain reconstruction of the cranium and the development of speech are the most outstanding characteristics of the later stages in the development of man is readily understood. This view is in complete accord with the teaching of Academician Marr on the development of speech and leads one to believe that Neanderthal man possessed only slight powers of speech.

B. MODERN RACES AND THEIR HISTORY

The anthropological study of the numerous nationalities of the Soviet Union provides a key to the solution of many cardinal problems of race formation and race systematization.

In recent years anthropological knowledge of Siberia and the Far East has been increased by extensive research as, for example, the Okhotsk Sea coast by M. G. Levin; the Amur River region by D. A. Zolotarev; among the Nentsi Samoyeds of northwestern Siberia by S. A. Shluger; the Keshms, a small group on the upper banks of the Yenisei River, by G. F. Debets; the Hants and the Mansi or Ostiaks and the Voguls of the lower Ob River by T. A. Trofimova and N. N. Cheboksarov; and the Selkups of the lower Ob by G. F. Debets. The material thus obtained has greatly enriched and rendered more exact existing information about racial types in Asia. It is becoming evident that the most characteristic type for the Asiatic continent, the so-called Mongoloid type, is far from homogeneous. Within this category exist many variations which are either local types or relics of ancient racial formations.

The dolichocephalic or mesocephalic Asiatic anthropological types are widely scattered throughout Siberia and the Far East. Variations are to be found at present among the Trans-Baikal Tungus, in places along the Amur River among the Golds, and on the Okhotsk Sea coast. It is necessary to investigate the relation of this undoubtedly more ancient anthropological type of Central and Eastern Siberia, the so-called Ural type. At present these two variations possess certain features in common, but at the same time there are essential differences in the form of the face and nose, as well as in other respects. The latest research shows that racial characteristics commonly attributed to Asiatic races—coarse hair, heavy upper eyelids with the Mongolian fold, flat faces, and others—do not prevail among the native population of Siberia.

If, in respect to southern Siberians, especially Turki groups, one may assume the blending of European elements in the formation of

their type, such an assumption is out of the question regarding the more northern Siberian groups. Among the latter, in some districts there is a definite aquiline nose somewhat resembling that of the North American Indian. Is this type the result of actual genetical relations, however remote? Is this Siberian aquiline nose peculiar to an independent group? Is the aquiline nose merely a secondary trait which arose through the convergent development of separate, isolated groups? These problems may be solved within the next few years.

Much new anthropological information has been obtained about the peoples of Central Asia, especially through the craniological study of medieval and older ethnic groups by V. V. Ginzburg, L. V. Oshanin, and others. More and more facts indicate that the dolichocephalic element of European appearance is widespread in Central Asia and that modern anthropological variations, among which the brachycephalic element is prevalent, are of later formation.

In the Caucasus anthropological research has been conducted for several years, as a result of which a great deal of comparative material⁴ has been obtained. Most of this extensive country has been investigated by districts, with the exception of certain regions in Daghestan and in the most mountainous regions of Georgia. The drawing of anthropological maps of the Caucasus is one of the few experiments made in anthropological analysis by districts based upon systematic observations made by groups of research workers. A summary of these data will be published in a special collection about the Caucasus, now being prepared for press by the Institute of Anthropology and Ethnography (IAE) of the Academy of Sciences.

New materials have corrected and complemented former views concerning anthropological types in the Caucasus. The existence of the mesocephalic, long-faced type with a straight nose, dark hair, often with blue or gray eyes, has been established in the northwestern Caucasus. This type is to be found among the Cherkess (Circassian)-Kabardinian peoples in the Kuban region and is clearly a variation of the so-called Pontic race. Morphological and historical data established the unity of the Kuban variation of the Pontic race with lower Danube types in Bulgaria, ancient types in present-day southern Russia, and others. In ancient times the above-described type was very widespread and predominated in what is now western Georgia.

In southeastern Transcaucasia there is another, also mesocephalic type, but it differs from the first in several respects. This type is to be found among Azerbaidzhanis, among a small group called the Tats

⁴ Cf. my forthcoming *Contributions to the Anthropology of the Caucasus*. (H. F.)

(remnants of the ancient Iranian inhabitants of this region), the Talyshees, the Kurds, and others. The Transcaucasian mesocephalic type, together with the mesocephalic variation prevalent among the Transcaspians, comprise a special group, the Caspian race, which is also a branch of the great Mediterranean race. Some groups in northern Iran⁵ also belong to the Caspian type. A third racial type, Pontozagros or Armenoid, is found in the central Transcaucasian highlands. This type is composed of several elements, some of more ancient origin than others. The region through which the Pontozagros type is distributed includes districts of southern Daghestan.

The three above-described racial types are also widespread outside the Caucasus. A fourth type, called the Caucasian race proper, is specific for the Caucasus. This type is similar to the Armenoid, but is characterized by a narrower head and a slightly different form of face and nose. This type is found in Georgia and partially in the central Terek region in North Caucasus. The results of the anthropological analysis of the population of the Caucasus fully accord with the latest data of archeology, linguistics, and ethnography, and make it possible to trace the history of modern ethnic types.

In recent years the racial analysis of the population in the European part of the Soviet Union has also advanced considerably.

A series of Neolithic skulls found in the Olonets Lake on Olenii Island and described by E. Zhiron is of great importance in the study of the anthropology of the Far North. This series includes a slightly brachycephalic element which is similar to the Lopar type, but which differs from the latter by virtue of certain Mongoloid features. The great age of this variation in northern Europe is beyond doubt. The connection between this element and the northern forest Neolithic peoples is also evident. The Neolithic brachycephals of the north should occupy a place of their own. There are no data that justify identifying them with the western European Neolithic brachycephalic types of Borreby in Denmark, and Grenelle⁶ in France.

A volume of the works of the Institute of Anthropology of the Moscow State University published in 1941 contains a number of essays on the anthropology of various Finnish peoples (articles by G. F. Debets, R. I. Zenkevich, and M. Gremiatskii). As has been observed by previous investigators, anthropologically the Finnish

⁵ See also Henry Field, *Contributions to the anthropology of Iran*, Field Museum of Natural History, Chicago, 1939.

⁶ This supposedly Neolithic skull, found near Paris in 1870, resembles the Azilian brachycephals of Ofnet in Bavaria. (H. F.)

peoples are not homogeneous. Baltic racial types are clearly distinguished among the Ladoga Finns, for example, among the small groups of Veps, while the Volga Mari (Cheremis) are a variation of the Ural type, and the Udmurts (Votiaks) contain elements close to the Lopar type. In the opinion of the above-mentioned authors it is to be expected that certain Finnish groups contain the neutral proto-Asiatic anthropological element or even more definitely Mongoloid elements. Such an anthropological type is outlined in craniological material belonging to the Iron Age, for example, the skull from Lugov.

In addition to ordinary anthropological investigation, certain other studies of elementary genetic features were conducted among the Finnish tribes—blood groups, reaction in a phenylthio-carbamide solution and especially to color sensitivity. The groups investigated proved very similar in these respects.

Work on the craniology of ancient Slavic tribes is being systematically conducted by T. A. Trofimova, who records differences among the southern Slav group of Severyans and the more northern Krivichi and Vyatichi. The former belong to the dolichocephalic variation, a Pontic form. Trofimova believes that among the latter, together with other elements, there are Asiatic or proto-Asiatic elements.

Several volumes by G. F. Debets treating of the craniology of the population of Russia in the epoch preceding the present one have been prepared for press. Debets has entitled his book "The Paleo-anthropology of the U.S.S.R.," but he includes in it osteological materials belonging not only to the Stone Age or to the prehistoric period in general, but to all later ages up to the seventeenth and eighteenth centuries. Debets has collected a quantity of craniological material preserved in central and local museums, all of which has been carefully checked in respect to dates and classified according to epochs and territories. This comprehensive summary gives a good picture of the craniological types and their alterations beginning with the Neolithic period until modern times through wide sections of Eastern Europe, Siberia, and Central Asia.

These data contain the solution of many anthropological problems in the U.S.S.R. Debets devotes much attention to the local transformation of craniological types, which occurred in many territories, and takes into consideration, at the same time, the change of types which took place as a result of the immigration of separate groups of the ancient population.

In addition to materials about Eastern Europe, the above-mentioned volume of the works of the Institute of Anthropology contains articles by N. N. Cheboksarov on racial types in modern Germany. Based

upon the careful study of all the factual material in literature, this work is a most complete and systematic summary greatly superior to anything on this subject heretofore printed. Cheboksarov's work corrects many widespread views concerning the racial composition of the population of Germany. While reaffirming the formerly expressed view concerning the limited distribution of the North European racial type proper and the preponderance of Baltic and Central European types in northern Germany, Debets points out that the Alpine type is also not the main element of which the present population of southern Germany is composed. This type spreads over a very small region. At the same time the existence of a peculiar complex of distinctive features, which Debets classifies with the Atlantic racial form described by Deniker, has been established in the upper Rhine zone.

The great advance in the modern theory of race formation and race analysis as compared with previous views is evident from the above review. The human race is not something unchangeable. In the course of ages the various distinctive features of human groups alter; the size of the population within which marriages among members take place grows or diminishes. As a result, the concentration of various hereditary features varies and under certain conditions changes take place in the average size of the group. At the same time changes in external conditions influence one and the same tendency. The influence of intergroup marriage, as well as group isolation, should be added to these two general factors of racial differentiation.

Considering these facts it would be incorrect to draw a line for racial types based on the absolute existence of one or another trait, or even of several traits. Observing the changes of features within a certain territory one can see that these changes are very gradual; for example, the region with the highest cephalic index is surrounded by a zone where this index is slightly lower, and so forth. The region where a certain feature is most clear is evidently that region where certain hereditary traits are most concentrated, or as it is usually called, the "center of distribution." The entire zone within which the trait alters in one direction (plus or minus) comprises the region of the distribution of one type, despite differences in magnitude. The boundaries of the type are located where the alteration is in the opposite direction, i.e., where, instead of finding a reduction of the average index, it begins to increase.

However, for races the combination of several features in a given territory is always characteristic, as for example, blue eyes, wide heads and tallness. The boundaries of the distribution of the racial

type are located where the given combination of features is replaced by another, for example, an increase in height when considered according to territory is accompanied by a darkening of eye color. The race, as a systematic category, is far from being the only taxonomic category. It is necessary to distinguish great races, simple races, sub-races, and local races. In such a consecutive subdivision the dynamic essence of the category "race" is revealed. A most important criterion in determining the race or subrace is the alteration of features according to territory. Those races which by anthropological analysis have been reconstructed in the modern epoch reflect groups that arose in the distant past. Evidently the types of great races arose in the Neolithic period. Outlines of the most primitive forms of some races are found in the Metal Age.

Such are the general views in the study of the race as a historical and dynamic category developed in the above-mentioned works as well as in a number of special investigations (concerning alterations in the length of the body, in the form of the skull, the general conditions of the alteration of the average index in population, the correlation of ethnic and somatic types, etc.).

Among the latest works on general problems in the study of races it is necessary to mention a series of mathematical investigations conducted by M. V. Ignatev, concerning the significance of cross-breeding, isolation, the conditions of the distribution of newly arising traits. G. G. Roginskii investigated the distribution of blood groups from the same viewpoint.

In the study of the geographical distribution of variations of ridge patterns of the fingers, N. V. Volotskoi used the "delta index" which expresses the total number of so-called deltas [triradii] per 10 fingers. Plotting the magnitudes of this index on world geographical maps revealed most important and more or less constant differences in racial groups.

C. VARIATIONS IN THE STRUCTURE OF HUMAN BODIES

The physical types of ancient and modern man is one of the main subjects of study in physical anthropology. However, no less important for this science is wide research in the variation of structure and the laws determining these variations. Only on the basis of a knowledge of ontogenetic alteration, the laws of correspondence and growth of parts of the body, and comparative anatomy can correct racial analyses be made and the earlier stages of the evolution of man be explained.

With the increase in anthropological knowledge, the number of concrete morphological problems grows. Much attention is paid not only to research in the variations of the structure of the skull and individual bones of the skeleton but also to the brain convolutions, the skin and hair, the bones and cartilage, the nose, eyelids, lips, muscles, internal organs, and outer forms of the body, and in the proportion of its parts.

In recent years a number of works in comparative anatomical research, the study of topographical and functional correlations, ontogenetic alterations and the laws of growth have been published.

In the period from birth to approximately 20 years of age, the growth of individual organs and parts of the body differs in respect to speed and length of time. For the organism in general the growth of the total size of the body, its length, weight, and chest measurement, is most characteristic. These measurements determine the size of the body surface and its volume. Available data establish a definite relation between the increase of the total size of the body and its separate parts.

As is known, during the growth period there are 3 to 4 years during which the annual increase in the total size of the body is very great. Some experts regard this so-called puberty phase in boys as extending from the ages of 11 to 15 and others from 12 to 17. An analysis of charts seems to indicate that puberty comes between 13 and 17 years for boys and 13 and 16 for girls. In comparing such widely differing groups in respect to body size as the Japanese and Americans, it is seen that variations in the above-mentioned periods are no more than 4 to 6 months.

At the same time another important circumstance becomes evident: a sharp increase in growth during puberty is characteristic for only one type. If growth is very intensive preceding puberty then the intensity of growth during the period of sexual maturing is hardly noticeable. On this basis it was possible to distinguish several types of growth and to find basic magnitudes according to which it is possible to establish the type of growth of the child in a comparatively short period of observation.

There is little relationship between the type of growth and the final size of the body. Both short and tall persons may grow according to the accelerated as well as the gradual type. At the same time it becomes clear that between the final size and the magnitude of the body at one or another age there is a relation which varies within comparatively narrow limits. In addition to being of great interest for understanding the formative process of an organism, the establishment

of these laws is most important for the correct estimation of the physical development of the child by the school doctor. In this respect theoretical anthropological research is closely connected with applied anthropometry.

Research in the physical development of various groups of children is most important and has become the subject of numerous theses written by medical workers. The anthropometric study of the sizes and proportions of bodies was necessary for the standardization of sizes for army clothing. A most important role was played by anthropometric work in controlling methods of physical therapy in treating wounds.

III. PALEOLITHIC SITES¹

INTRODUCTION²

The material³ based on data available during 1938 has been arranged chronologically from the Clactonian and Primitive Mousterian to the Epipaleolithic, and is divided geographically⁴ into the Euro-

¹ This excellent study was translated by Mrs. John F. Normano, The Asia Institute, 7 East 70th St., New York City. The text was then edited and condensed. Diacritical marks were omitted. Eugene V. Prostov checked the spellings and made some minor revisions in order to conform to our previously published articles. Under each site the bibliographical references have been omitted because the majority of these Russian publications are not available in United States libraries. However, the entire text in Russian has been placed on Microfilm No. 2414, pp. 1-38, in the American Documentation Institute, 1719 N St., NW., Washington 6, D. C., where a copy may be purchased. Since this list must be considered as separate and usually unrelated items, the names of the excavators have been retained. This volume was given to me by S. P. Tolstov, Director, Ethnological Institute, Academy of Sciences of the U.S.S.R., Moscow, while I was a guest of the Jubilee Sessions of the Academy in Moscow and Leningrad during June-July, 1945. See *Anthropology in the Soviet Union, 1945*, Amer. Anthropol., vol. 48, No. 3, pp. 375-396, 1946; especially bibliography in footnote 57. There are many references to these Paleolithic sites in our published articles (see p. 66, footnotes 1, 2).

² Throughout the text the use of the metric system has been retained and all heights are given as above sea level unless otherwise specified. The abbreviation IAE has been used for the Institute of Anthropology and Ethnography, Academy of Sciences of the U.S.S.R., Leningrad. Some technical descriptions have been included from A. J. H. Goodwin, *Method in Prehistory*, the South African Archaeological Society Handbook, No. 1, Cape Town, 1945, and from M. C. Burkitt, *Prehistory*, Cambridge University, 1925. (H. F.)

³ From P. P. Efimenko and N. A. Beregovaia, *Paleolithic Sites in the U.S.S.R.*, *Materialy i Issledovaniia po Arkheologii SSSR*, No. 2, pp. 254-290, Moscow and Leningrad, 1941.

⁴ According to Prostov, for the convenience of readers having access to other than Soviet maps, the names of various administrative subdivisions of the U.S.S.R. have been given in the nonadjectival form of the name of the city after which the subdivision was named. This is followed by the designation in Russian for the type subdivision. This latter, for which there is no exact English equivalent, is given in italics, as follows:

Raion (*Aimak* in Central Asia and Buriat Mongolia), a rural subdivision corresponding to a United States county.

Okrug, a larger subdivision currently used for several special areas.

Oblast, a major administrative subdivision (province) of a republic.

Krai, a major administrative subdivision in a sparsely populated border area (territory) of the R.S.F.S.R.

pean part of the R.S.F.S.R., the Ukraine, Bielorrussian S.S.R., the Crimea and Caucasus, and the Asiatic part of the U.S.S.R.

The monuments of the so-called Arctic Paleolithic represent a special group. In view of the numerous Epipaleolithic finds, only the better-known and more thoroughly investigated sites have been included. However, a few well-known sites of doubtful age have not been omitted.

PRIMITIVE MOUSTERIAN AND CLACTONIAN SITES

BLACK SEA LITTORAL: ABKHAZIA⁵ AND CRIMEA⁶

1. *Anastavka*.—Flints of Mousterian type were found on the right bank of Kodor River near this village. A number of flints were collected on exposed areas associated with ferruginous manganese concretions. In addition, on the surface of the fourth terrace occurred older flints of IAshtukh type with a different patina. This material was obtained during 1932 by an IAE⁷ expedition.

2. *Apiancha*.—Single flints of IAshtukh type were found on the upper platform of Apiancha Mountain between its two summits at 600 m. above sea level. The flints are distinguished by smooth facets, a deep patina and a brilliant surface. This material was obtained during 1935 by an IAE expedition.

3. *Atap*.—A few characteristic flint implements, including a hand ax, of Acheulian or Primitive Mousterian type were found on the surface of the terrace near this village. On a lower terrace were flints of Upper Paleolithic type. This site was discovered during 1935 on an IAE expedition.

4. *Byrts*.—Single flint flakes of IAshtukh type were collected on the platform of Byrts Mountain near Sukhumi about 450 m. above sea level. The first finds were made during 1934 by L. N. Solovev.

5. *Gali*.—On this site the IAE expedition found an Acheulian hand ax reutilized as a nucleus in Mousterian times.

6. *Gvard*.—Flaked flints, similar to the most ancient group from IAshtukh, were found in a Karstian declivity on the outskirts of the village (450 m.) on the slopes of Gvard Mountain. The first series was obtained during 1934 by L. N. Solovev.

7. *Kolkhida*.—Flints of Clactonian and Primitive Mousterian type were found on the top and on the slopes of the hill, representing

⁵ Nos 1-14.

⁶ No. 15.

⁷ Institute of Anthropology and Ethnography, Academy of Sciences of the U.S.S.R., Leningrad.

the 180-m. terrace at this village near Novye Gagry. These surface flints originated in a lower horizon associated with iron manganese concretions. While the material assembled by the IAE expedition during 1935 is not large, its value lies in the uniformity of the series. Some of the flints bear traces of utilization.

8. *Kiurdere*.—On the surface of an ancient terrace flints of Primitive Mousterian (Acheulian) type were found by S. N. Zamiatin during 1934 at Kiurdere near Psyrtskhi on the left bank of the Shitskhuara River, near its exit from the gorge. A hand ax and tools made from crude flakes were found not only on the surface of this terrace, but also in the ancient alluvium along the slope of the neighboring limestone ridge.

9. *Okum*.—See No. 48.

10. *Sukhumi*.—Flints of IAshtukh (Primitive Mousterian or Acheulian) type can be found within the city limits, on the banks of the Sukhumka River, which cuts through the fourth terrace at IAshtukh site, as well as in the nearby surrounding area on the top of Cherniavskii Mountain and in the Ostroumov gorge. These discoveries were made during 1935 by an IAE expedition.

11. *Tabachnaia*.—During 1936 on the surface of the 100- to 110-m. terrace at the Zonal Tobacco Experimental Station near Sukhumi, L. N. Solovev found flint flakes of Primitive Mousterian type and a hand ax as well as some flints of Upper Paleolithic appearance.

12. *Tekh*.—In the valley on the road from Tsebelda to Tekh, at 350-400 m. above sea level on the surface of the clayey loam, L. N. Solovev found during 1936 flints of Primitive Mousterian type. Some tools and laminae of Upper Paleolithic appearance were collected.

13. *Chuburiskhindzhi*.—A few crude flakes and implements, including one hand ax, of dark pink and gray Turon flint were collected on the right bank of a stream along the road 12 kilometers southeast of Gali near Satandzhio Mountain. These specimens, contemporaneous with the surviving vestiges of the old fifth terrace, showed signs of utilization and were deeply patined. Ridges between facets were worn smooth. This site was located during 1935 by an IAE expedition.

14. *IAshtukh*.—Flints of Acheulian or Primitive Mousterian type were found on the surface of the fourth terrace (100 m.) near Nizhnii IAshtukh, 3 kilometers north of Sukhumi, in the gorge between Byrts and IAshtukh Mountains. The flints, including discoidal nuclei, massive flakes and implements manufactured from them, as well as hand axes, lay on the large platform, often on the surface, sometimes among pebbles under the diluvial clay. Typologically later flints of

Mousterian and Upper Paleolithic appearance were also found, but are linked stratigraphically with the upper levels of the clayey loam. The first collection was made during 1934 by S. N. Zamiatnin.

15. *Kik-Koba*.—Remains of Primitive Mousterian type were found in the lower stratum above bedrock in this cave, situated on the right bank of the Zuiia River near Kipchak, which lies about 25 kilometers east of Simferopol. Here were excavated by G. A. Bonch-Osmolovskii during 1924-1926 numerous flint implements and flakes associated with remains of *Cervus elaphus*, *Equus*, *Bos*, *Saiga*, *Sus scrofa*, etc.

MOUSTERIAN SITES ⁸

16. *Kodak*.—This site, located on the high right bank of the Dnieper 10 kilometers southeast of Dnepropetrovsk, was discovered during 1932 through the accidental finds of several flints associated with Pleistocene fauna. Further investigations were conducted during 1934-1935. These finds lay in the bottom of the deep ravine of Nizhniaia Sazhavka, which cuts the loess bank of the Dnieper, at a distance of 1 kilometer from the river. The stratigraphy consists of 20.0 m. of loess with several horizons of buried topsoil, ancient diluvium from ravines, red-brown clays, variegated clays, and granite bedrock. Nearer to the mouth of the ravine the alluvium of the gulleys is replaced by stratified sands containing fresh-water Mollusca typical of stagnant and slow-flowing waters. Mousterian remains were found in the base of the stratified gray-greenish sands (ravine alluvium) overlain by loess. Below, the sands were mixed with gravel. The cultural stratum was evidently partly washed away. The flints, together with crushed bones, lay in the lower part of the stratum among the pebbles and gravel. Above were also found animal bones. The fauna is represented by *Elephas trogontherii*, *Rhinoceros trichorhinus*, *Bison priscus*, *Equus equus*, *Cervus megaceros*, *Rangifer tarandus*, *Felis spelaea*, *Ursus arctos*, etc.

The several dozen tools were mainly of dark-brown flint, but some were of quartz and compact sandstone. There were: biface points, a discoidal nucleus used as a carinate scraper, scraping tools, broad laminae, etc. Incisions could be seen on the phalanges of the large

⁸ The geographical distribution of these sites is as follows: The middle course of the Dnieper (No. 16), the basin of the Desna (Nos. 17-18), northern Donets (Nos. 19-21), the Crimea (Nos. 22-23), the coast of the Sea of Azov (No. 20), Kuban (No. 30), Kuma (No. 31), the northern part of the Caucasian coast (Nos. 32-36), Abkhazia (Nos. 37-54), Mingrelia (No. 55), and Uzbekistan (No. 56).

deer; they resembled those found on the "small anvils" of the Mousterian period.⁹

17. *Chulatovo III*.—Rolled flints of Mousterian type were found during 1938 eroded from the bank of the Desna River near Chulatovo near Novgorod-Seversk.

18. *Svetilovichi* (Bielorussia).—Accidental finds on the second terrace above the flood plain of rolled and patined points of Mousterian type were made during 1929 by P. N. Chaikovskii, a teacher who studied the region, on the right bank of the Baseda River in the ravine of Kamennaia Gora near Svetilovichi. These implements were described in 1937 by K. M. Polikarpovich.

19. *Derkul*.—This Mousterian station, largely destroyed by the river, stands near Kolesnikovo farm on the right bank of the Derkul River, a left tributary of the northern Donets River, above its mouth. The Paleolithic remains lie in a stratum of finely rounded flint gravel. This stratum divides two layers of sandy alluvium, of which the lower one, covering the surface of the marl, represents the remnants of the ancient third above the flood-plain terrace of the Derkul River. The only bone found was that of a large mammal. The tools were mainly of quartzite. This site was discovered during 1924 by P. P. Efimenko and studied by him during 1924-1926 and 1930.

20. *Kamenskaia*.—Bones of mammoth and other animals were reported but unconfirmed from the ancient gravel deposits near the Cossack village of Kamenskaia, in the Donets region, near the confluence of the Rychnitsa River with the Northern Donets. The discovery of a discoidal nucleus was reported.

21. *Krasnyi IAr*.—Many large flint flakes and implements of Mousterian type, including points, scrapers, etc., were collected during 1925-1926 by S. A. Loktushhev close to the Northern Donets River, 15 kilometers southeast of Voroshilovgrad [formerly Lugansk]. This station is about 1 kilometer southeast of Krasnyi IAr farm, on the right bank of the river.

22. *Adzhi-Koba*.—This cave of the corridor type, located on the western slope of Korabi-IAila in the mountainous region of the Crimea, was investigated by G. A. Bonch-Osmolovskii during 1932-

⁹ Cf. at La Quina, Charente district of France, discovered by the late Dr. Henri-Martin and reported from Teshik-Tash near Tashkent. (H. F.) The use of a bone rest or anvil was common in Europe even before the Middle Paleolithic when many large splinters of bone are found to bear indentations and scratches caused by "rest percussion." The bone was used in much the same way that we might use a bench, to steady and support the artifact while fine percussion or pressure was used. (A. J. H. G.)

1933. It contains two horizons: the upper of the Late Paleolithic type of Siuren I with northern deer; and the lower of Mousterian type with saiga antelope, northern deer, rhinoceros, wild donkey, Arctic fox, polecat, etc.

23. *Volchii Grot.*—This Mousterian cave situated on the right bank of the Beshtirek River at Mazanka near Simferopol, was discovered and investigated by Merezhkovskii during 1880. He found, mixed with ashes and charcoal, a Mousterian point, a small hand ax, and remains of mammoth, wild horse, *Bos*, giant deer, and saiga antelope in the yellow Quaternary stratum. During 1938 O. N. Bader discovered here a rich Mousterian deposit.

24. *Kiik-Koba.*¹⁰—The upper cultural horizon of this cave (see also No. 15) lies in the stratum of yellow clay mixed with crushed rock and is divided from the lower horizon, containing the Lower Mousterian inventory, by a sterile band. The majority of the implements were points (some biface) and scrapers. The fauna included the mammoth, woolly rhinoceros, wild horse, wild donkey, primitive *Bos*, wild boar, cave bear, hyena, fox, rodents, and birds. Some of the bones bore traces of incisions, suggesting use as small anvils¹¹ or for pressure flaking. This was the site of the destroyed burial containing Neanderthal remains.¹²

25. *Kosh-Koba.*—Traces of an apparently Mousterian cave, 25 kilometers from Simferopol on the right bank of the Zulia River next to Kiik-Koba. During 1923 G. A. Bonch-Osmolovskii found two large hearths, a few flints, and many animal bones, partly split, including mammoth, rhinoceros, cave hyena, giant deer, bison, saiga antelope, horse, wild donkey, fox, marmot, etc.

26. *Chagorak-Koba.*—This Middle Paleolithic cave near Kainaut in the Karasubazar region in the Crimea was discovered by O. N. Bader during 1935 and studied by him during 1936-1937. The fauna, including the woolly rhinoceros, wild horse, saiga, and cave hyena, was found in the Quaternary stratum during 1936. In the following year in the same stratum several flint implements of Mousterian type were unearthed.

27. *Chokurcha.*—An Upper Mousterian cave in the valley of Malyi

¹⁰ On July 2, 1945, the Director of the Ethnological Institute of the Academy of Sciences of the U.S.S.R., asked me to transmit to the Chicago Natural History Museum, formerly Field Museum of Natural History, a cast of the Kiik-Koba skeleton. Although since 1942 no longer curator of physical anthropology, I forwarded it to Chicago. (H. F.)

¹¹ See footnote 9.

¹² One wrist had been found.

Salgir stream near Chokurcha, 2 kilometers northeast of Simferopol, was discovered and investigated by S. I. Zabnin during 1927 and excavated in 1928 and in the following years. The cultural remains of the Quaternary period occur in the yellow clayey loam containing crushed rock, which extends to the rocky bottom of the cave and continues all along the slope where it attains about 4.0 m. in thickness. More than nine thin cultural levels with traces of hearths were recorded in this alluvial deposit. On the slope in front of the cave was found an accumulation of split mammoth bones, associated with a considerable thickness of the cultural stratum. The flint inventory consisted of a large quantity of unifaced and bifaced tools. A few bone awls were found. Included in the fauna were the mammoth, cave hyena, cave bear, rhinoceros, saiga antelope, *Bos*, *Cervus*, and fox.

28. *Shaitan-Koba*.—A Late Mousterian cave located on the right slope of Bodrak Valley, near a tributary of the Alma River, at Tau-Bodrak near Simferopol. This cave, discovered by S. N. Bibikov during 1928, was investigated by G. A. Bonch-Osmolovskii during 1929-1930. The cultural remains occur in the Quaternary gravels, in the limestone stratum of the rock shelter and also on the scree slopes. Large flint tools of local dark flint were found together with typical Mousterian implements; the inventory included prismatic laminae, scrapers, burins, etc. The fauna included mammoth, cave lion, cave hyena, wild horse, saiga, Arctic fox, rodents, etc.

29. *Bessergenovka*.—During 1933 V. I. Gromov and V. A. Khokhlovkina found Mousterian flakes beneath the Rissian loess near Taganrog on an ancient terrace on the coast of the Sea of Azov.

30. *Il'skaia*.—This Upper Mousterian site lies near the Cossack village of Il'skaia on the left slope going to the valley of the Ilia River. The cultural deposit, 0.5 m. in thickness, extended over a wide area in the upper part of the second terrace, 15.0 m. above the Ilia River. The fauna included a considerable quantity of bones of the primitive *Bos*. The simplest implements were made of bone. Discovered by Baron Joseph de Baye during 1898, investigated by S. N. Zamiatnin in 1925, 1926, and 1928, and by V. A. Gorodtsov in 1936 and 1937.

31. *Podkum'skaia*.—A calvarium and other fragmental human bones were found in 1918 at Piatigorsk during sewer construction. These remains were described by M. Gremiatskii. The possibility of assigning these remains to the Mousterian period or to any part of the Paleolithic is now seriously challenged.

32. *Akhshtyr cave*.—Four kilometers from Golitsyno in the Adler Raion on the right bank of the Mzymta River, Mousterian flints were

found during 1936 by S. N. Zamiatnin, who continued excavation during the following 2 years. (See pls. 1-4.)

33. *Navalishino cave*.—Located in the Adler *Raion* near Navalishino, on the Kudepsta River, the lower part of this cave belongs to the Mousterian period. The characteristic flint inventory and numerous cave bear remains were found by S. N. Zamiatnin during 1936.

34. *Khosta* ("The White Rocks").—Mousterian flints were found during 1936 in gullies on the precipitous banks of a ravine about 5 kilometers from Khosta near the paved highway to Vorontsov.

35. *Natsmen*.—Further downstream of the Khosta River than the site of No. 34 and on the opposite bank, on the southern slope of Akhum Mountain in the territory of the Kolkhoz "Natsmen," there was found during 1935 another site with implements and flakes of Mousterian type.

36. *Pauk*.—Crude flints of Mousterian type were found on the plowed surface of the ancient 100-m. terrace in the region of Tuapse, behind Kadoshinskii Cape on the territory of the rest camp near Pauk Mountain.

37. *Anastasevka*.—Here were found Mousterian flints. (See No. 1.)

38. *Akhbiuk*.—Traces of an Upper Mousterian site were identified on the surface of the 80-m. terrace near Akhbiuk Mountain, 6 kilometers north of Sukhumi. Discovered by L. N. Solovev during 1935, this open-air station was investigated by an IAE expedition.

39. *Achigvari*.—Typical Mousterian flakes were collected on the surface of the 30-m. terrace.

40. *Bzyb*.—Mousterian flints were found on the right bank of the Bzyb River near Kilometer 16 of the paved highway.

41. *Bogoveshita*.—A few characteristic Mousterian flint implements were collected during 1936 on the surface of the third terrace and along the Pshap River higher on the slope near this village.

42. *Gali*.—Typically Mousterian and Upper Paleolithic flints were found on the surface of the diluvial loam, which covers the ancient 80- to 100-m. terrace. The first discoveries were made by L. N. Solovev during 1935. (See No. 5.)

43. *Ilori*.—Several Mousterian flakes were collected by L. N. Solovev during 1935 in the yellow loam of the 16-m. terrace.

44. *Kelasuri*.—Upper Mousterian implements were found during 1935 by an IAE expedition on the surface of the third terrace and partly also in the slope of the fourth terrace, on the left bank of the Kelasuri River. This site lies on the estate of the All-Union Institute of Sub-Tropical Cultures.

45. *Lemsa*.—On the slopes of the ravine about 300 m. above sea level Mousterian flints were found in a cave and on the edge of the plateau.

46. *Lcchkop*.—Mousterian flints were collected on the surface of this terrace near Sukhumi by the IAE expedition during 1935. The same type of implements were also found nearby by L. N. Solovev during 1936 on the 10- to 12-m. terrace.

47. *Mokva*.—Some characteristic Mousterian flints, including discoidal nuclei, were found on the 10- to 12-m. terrace, 2 kilometers from the upper terrace.

48. *Okun*.—A large series of Mousterian flints were found on the tea plantations of the State farm "Chai-Gruzia" near Achigvany on the surface of the 80-m. terrace above the left bank of the Okum River. Among the implements was one finely worked hand ax. The surface of these flint implements bore a characteristic luster and some had traces of iron manganese concretions, which confirms their original location in the ancient horizon. Higher on the same slope typologically older flints were collected. This material was collected by the 1935 IAE expedition.

49. *Ochemchiri*.—Characteristic Upper Mousterian flints were found at the edge of the third (35-m.) terrace, 1 kilometer from Ochemchiri on the paved highway along the Sukhumi River. Lying partly in situ in the loam with iron manganese concretions, the flints appeared dark red with a brilliant, dark-brown patina. The first finds were made by L. N. Solovev. During 1934-1935 this site was explored by an IAE expedition with the participation of two geologists, G. F. Mirchink and V. I. Gromov.

50. *Tabachnaia*.—Mousterian flints were found near here. (See No. 11.)

51. *Tskhiri*.—Some Mousterian flints were found by the 1935 IAE expedition on the surface of the 30-m. terrace.

52. *Esheri*.—A few Mousterian flints were collected on the surface of the eroded 80-m. terrace in a stratum of pebbles near this village by an IAE expedition during 1935.

53. *Iagish*.—A few Mousterian flints were collected by the 1936 expedition from IAE on the elevated plateau 450-500 m. above sea level.

54. *IAshtukh*.—Mousterian flints were found here. (See No. 14.)

55. *Rukhi I*.—On the low ground, which is flooded by the Rukhi River in the spring, about 6 kilometers from Zugdidi, A. N. Kalandadze discovered during 1936 typologically Mousterian flakes.

56. *Teshik-Tash*.—This cave, situated on the northwestern slope

of the Baisun-tau Mountains at 1,500 m., lies 18 kilometers from Baisun in the Turgan-Darya Valley of southern Uzbekistan. Here were discovered five Mousterian strata. The flint inventory consisted of discoidal nuclei, typical triangular flakes, crude chopping tools, scrapers, and small bone anvils.¹³ The fauna included *Capra sibirica* and, less often, horse, boar, leopard, marmot, and a rodent (*pish-chukha*). The skeleton of a Neanderthaloid child¹⁴ was found here by A. P. Okladnikov during 1938. This represents the first Paleolithic site discovered in Central Asia.

UPPER PALEOLITHIC AND EPIPALEOLITHIC SITES

EUROPEAN PART OF THE R.S.F.S.R.¹⁵

57. *Anosovka*.—An Upper Paleolithic site was located near Kostenki in the Gremiachenskii Raion of the Voronezh Oblast. Finds were made by the Kostenki expedition during 1936. The cultural stratum is stained deeply by red ocher. The animal bones include many fragments of antlers.

58. *Borshovo I* (Kuznetsov Log).—Located on the northern border of this village in the Gremiachenskii Raion of the Voronezh Oblast on the bank of the Don, the cultural remains and bones of animals, mostly mammoth, lay not very deep in the diluvial deposit along the slope of the gully. The flint inventory is characterized by flint points with lateral flakes removed, which date this site in either the Aurignacian or Solutrean period. Discovered by A. A. Spitsyn during 1905, it was investigated by S. N. Zamiatnin in 1922 and by P. P. Efimenko in 1923 and 1925.

59. *Borshovo II*.—The lower and middle horizons of this site lie on the right bank of the Don near Borshovo, Gremiachenskii Raion of the Voronezh Oblast. These two horizons, containing mammoth bones (especially numerous in the lower horizon), belong to the

¹³ See footnote 9.

¹⁴ On June 16, 1945, in the Anthropological Laboratory of the University of Moscow I had the privilege of examining the reconstructed Teshik-Tash skull, which will be published during 1948 by Bunak and Okladnikov. For photographs of this skull and reconstructions by M. M. Gerasimov, see Henry Field, Illustrations of the Teshik-Tash Skull, Amer. Journ. Phys. Anthropol., vol. 4, No. 1, pp. 121-123, 1946.

¹⁵ In the European part of the R.S.F.S.R. will be described the following stations: the Don (Nos. 57-70), the Oka (Nos. 71-79), the basin of the Desna (Nos. 80-85), the Seim (No. 86), the Upper Dnieper (No. 87), the Upper Volga (No. 88), the Middle Volga (Nos. 89-94), the basin of the Kama (No. 95), the southern Urals (Nos. 96-99), and the Sea of Azov coast (No. 100).

Magdalenian period. This site was first located during 1922 by P. A. Nikitin. The excavations were made by P. P. Efimenko in 1923, 1925, and 1929, and by P. I. Boriskovskii in 1906.

60. *Borshevo II*.—The upper horizon corresponding to the stratum of buried soil belongs to the end of the Magdalenian or to the Early Azilian period. No mammoth bones were found. This cultural stratum slopes gradually down to the side of the mouth of the Borshevo gully and finally goes under the level of the Don River. (See No. 59.)

61. *Borshevo III*.—At the mouth of Vishunov ravine, which cuts the high Cretaceous right bank of the Don between Kuznetsov gully and Borshevo ravine, at the time of first excavations made by P. P. Efimenko during 1923, on the terrace of the bank was discovered the accumulation of mammoth bones. Excavation by P. I. Boriskovskii in 1936 also yielded the bones of *Bos* and other animals, and isolated flints.

62. *Gagarino*.—This Aurignacian-Solutrean site, on the left bank of the Don, higher than the mouth of the Sosna River, near Gagarino in the Voronezh *Oblast*, is located on the northern slope of the ravine, which leads to the Don Valley. The cultural remains lie directly under the black earth (*chernozem*) in the upper part of the brown loess. Limestone blocks indicated the walls of the shallow dugouts. Among faunal remains mammoth bones were the most numerous, but there were also represented the woolly rhinoceros, northern deer, bison, Arctic fox, and rodents. The flint inventory is characterized by the presence of points with lateral flakes removed (cf. No. 58). In addition to bone tools, S. N. Zamiatnin found, during 1927 and 1929, female figurines made from the tusk of a mammoth.

63. *Kostenki I*.—This Lower Solutrean site near Kostenki in the Gremiachenskii *Raion* of the Voronezh *Oblast* stands on the right bank of the Don about 30 kilometers south of Voronezh. Here were found the remains of a large encampment, forming an oval plateau covered with traces of habitation, with the line of hearths following its longitudinal axis. This area was occupied by numerous pits used as storerooms. Around this surface construction were found considerably larger pits or storerooms and three dugouts. In addition to a large series of flint implements and animals bones, there were also art objects including 42 female figurines (mainly in fragments), many sculptures of animals, complete figures, heads, etc. Represented in the fauna were a quantity of mammoth bones, as well as the horse, Arctic fox, cave lion, bear, wolf, and hare. Only single finds of musk ox and northern deer came to light. The cultural stratum lies under the fertile black earth (*chernozem*) in the upper part of the diluvial

loess-argillaceous soil. At the base of this clay were discovered, during 1931, traces of an older settlement attributed to the beginning of the Upper Paleolithic. Here were found mammoth, horse, and saiga antelope. The excavations at Kostenki I were made by P. P. Efimenko during 1931-1936. The first account of these Paleolithic dwellings was mentioned by I. S. Poliakov in 1879 and by A. I. Kelsley in 1881. Some excavations were made by S. A. Krukovskii in 1915, by S. N. Zamiatnin in 1922, and by P. P. Efimenko in 1923. Two nearby sites, similar to the above-described dwellings, were found later by Efimenko.

64. *Kostenki II*.—This Lower Magdalenian site on the right bank of the Don is located at the mouth of Anosov gully, where it merges with the Don Valley. The cultural remains consist of a rich accumulation of mammoth bones with traces of hearths. The fauna also included single examples of the horse, hare, Arctic fox, and bear. The implements, mainly made from flint boulders, consisted for the most part of crude burins. The crudest type of bone tools were also found. This site was discovered and investigated by P. P. Efimenko during 1923 and by S. N. Zamiatnin in 1927.

65. *Kostenki III*.—A Lower Magdalenian station on the bank of the Don near the mouth of Chekalin gully; apparently this location was mentioned by Omelin in 1769. The cultural stratum of yellowish loam, about 2.0 m. deep, lies in a narrow depression in the escarpment. In addition to the mammoth, the fauna is represented by a few bones of the horse, Arctic fox, and hare. The flint tools, of Cretaceous and boulder flint, are small, with primitive chisels prevailing. Rare finds of crude bone implements were made. This site was investigated by P. P. Efimenko during 1925 and by S. N. Zamiatnin during 1927.

66. *Kostenki IV*.—This Lower Magdalenian site stands on the right bank of the Don at the mouth of Aleksandrovskii (Biriuchii) gully. Located at the merging point of the gully and the low terrace, which is partly covered with water in the spring, the cultural stratum lies in the clay at a depth of 1.5 m. In the fauna the mammoth predominated, but there were also represented the horse, hare, and Arctic fox. The flint inventory was more diverse than at Kostenki II and Kostenki III. A few simple bone implements were excavated. Kostenki IV was discovered and investigated by S. N. Zamiatnin in 1927 and by A. N. Rogachev in 1927 and 1928. Rogachev discovered two large, elongated above-ground dwellings. The interior, slightly below the surface of the ground, was filled with refuse. Each building had more than 10 hearths in one line and consisted of four or five round houses 5-7 m. in diameter, closely adjacent and merging

with each other. Part were dugouts with the floor 0.6 m. deep. The general planning of this settlement is slightly similar to that of Kostenki I.

67. *Kostenki V*.—This station lies deeper in Pokrovskii gully than Kostenki I, which faces it on the right side of the gully. In the side fork of the gully (the first from the mouth) are two Upper Paleolithic sites, discovered by Efimenko during 1928. The first, located in the lower part of the side gully near the brook, yielded a great accumulation of mammoth bones and some flint implements. Since the cultural stratum lies beneath the loess and Cretaceous crushed pebbles, this monument should be attributed to the early phase of the Upper Paleolithic. The second Upper Paleolithic site lies higher, on the ascent of the elevation on Mirkina Mountain.

68. *Streletskaia*.—Traces of an Upper Paleolithic site at the mouth of Aleksandrovskii gully near Kostenki in Voronezh *Oblast* were found on the right side of the gully opposite Kostenki IV on the low terrace at the foot of the bank. Zamiatnin discovered here during 1927 typologically Upper Paleolithic flints and bones of mammoth. Excavations made by P. P. Efimenko corroborated the discovery of this site, which was presumably eroded, the result of being only slightly above the waters of the Don.

69. *Telmanskaia Stoianka*.—Situated in the fork of two gullies before they reach the Don Valley, this site is located on Kolkhoz "Telman." Discovered by A. N. Rogachev in 1936 and investigated by S. N. Zamiatnin in 1937, the main excavation revealed a circular dwelling of dugout type with the hearth near its entrance. The flint inventory combines the typical Lower Solutrean implements (laurel-leaf points) and Mousterian forms. In the fauna the mammoth predominated. Many implements were manufactured from bones.

70. *Shubnoe*.—An accumulation of Quaternary animal bones were excavated near this village in Voronezh *Oblast* about 15 kilometers west of Ostrorozhsk. In addition to many bones of the mammoth and horse, there were fewer of *Bos primigenius* and rhinoceros and a few of *Cervus elaphus* and *Cervus megaceros*. At the outlets to the ravine were solitary unretouched flints. This station was discovered by S. N. Zamiatnin in 1925 and investigated by him in 1933.

71. *Gremiachec*.—This Epipaleolithic¹⁶ site stands on the right bank of the Oka River opposite the mouth of its tributary, the Zhizdra. Discovered and investigated by N. I. Bulychev at the end of the 1890's, this station is situated on the sandy hill at the level of the flood plain. The finds lay in the upper stratum of the loamy

¹⁶ Attributed to the so-called "Sviderskian Phase" of the Epipaleolithic period.

alluvium. The flint tools were made from knife-shaped laminae. Three arrowheads with handles were found, but no animal bones or bone implements.

72. *Elin Bor*.—This Epipalaeolithic¹⁶ site stands on the left bank of the Oka River near Elina, 25 kilometers farther upstream from Murom. Discovered in 1878 by P. P. Kudriavtsev,¹⁷ P. I. Borisovskii in 1934 investigated the remains of the site on the sandy hill 1 kilometer south of the village. The flint inventory¹⁸ consisted mainly of elongated laminae, nuclei, scrapers, chisels, arrowheads, and many flakes. No bone implement or animal bones were found.

73. *Karacharovo*.—A Lower Magdalenian station on the left bank of the Oka, about 3 kilometers upstream from Murom, was found near this village. Discovered by A. S. Uvarov during 1877, Karacharovo was investigated by him together with I. S. Poliakov and V. B. Antonovich during 1877-1878. Situated on the left slope of the Karacharovo ravine near its mouth, the Paleolithic remains lay in the lower part of the loesslike loam at a depth of 1.0-1.5 m. The cultural stratum, with a disorderly accumulation of animal bones, covers the surface of about 1.5 sq. m. While mammoth remains predominated, bones of *Rhinoceros*, *Bos*, and *Cervus* were also excavated. The flint implements were made from boulders.

74. *Mel'tinovo*.—Fragments of bones of fossil animals and some flint flakes were found in the valley of the Dolets, upstream from Belev, along the Oka River, near Mel'tinovo. The Paleolithic age of the flints has not been determined.

75. *Okskaia*.—K. Lisitsyn described an Upper Paleolithic station in the alluvial deposit of the spring-flooded terrace of the Oka River. The cultural stratum comprises broken and charred bones of *Bos*, *Sus*, etc., fish vertebrae, and fresh-water Mollusca. It may well be that this site should be attributed to a later era.

76. *Stenino*.—Mammoth bones and flint implements were found in the vicinity of Kozelsk, along Trostianka brook, part of the basin of the Zhizdra River. According to N. I. Krishtafovich the fauna included mammoth, rhinoceros, elk, and deer. The flint and bone tools were not described. The first report was in 1900 from I. Chetyrkin.

77. *Skhodnia*.—Part of a human calvarium was found during 1936 at a depth of 4.0 m. in the valley of the Skhodnia River, a left tributary of the Moskva River, 12 kilometers north of Moscow during the construction of the Volga-Moscow Canal. According to G. F. Mirchink, this find belongs to the end of the Wurmian or to the beginning of the following era.

¹⁷ He collected surface specimens from local sand dunes during 1878-1894.

78. *IAsakovo*.—A quantity of Quaternary animal bones were found near Troitsa-Pelenitsa on the ancient terrace on the right bank of the Oka River at IAsakovo Station on the Moscow-Kazan Railroad. Discovered by P. P. Efimenko in 1922, this station was investigated in 1934 by P. I. Boriskovskii, who also found here in an untouched stratum several worked flints of Upper Paleolithic type.

79. *IAsnikolskoe*.—Bones of *Cervus megaceros*, horse, and some other animals were found near the efflux of the small riven Aksen, a tributary of the Mostia, on the watershed between the Oka and the Don. The bones were in the alluvial clay beneath a stratum of peat. The so-called flint and bone implements are of doubtful human manufacture.

80. *Timonovka*.—On the right bank of the Desna River near Briansk this Magdalenian site is situated on the side of the ravine which slopes down to the Desna. The finds consist of many flint and bone implements. The fauna is represented by the mammoth, northern deer, Arctic fox, etc. This site was excavated by M. V. Voevodskii in 1926 and by V. A. Gorodtsov from 1928 to 1933. The latter found the remains of houses.

81. *Suponevo*.—This former Magdalenian station stands on the right bank of the Desna, 4 kilometers south of Briansk. Situated on the second terrace above flood plain one can find traces of some kind of constructions and an accumulation of mammoth bones. The fauna included mammoth, rhinoceros, northern deer, bison, horse, Arctic fox, etc. Suponevo was investigated during 1926-1928 by P. P. Efimenko, B. S. Zhukov, and others.

82. *Eliseevichi*.—On the right bank of the Sudost River, a right tributary of the Desna near this village in the Pochep Raion, a Lower Magdalenian station was located. The cultural remains lay in the loess, covering the second terrace of the Sudost River. They consist of dwellings, an accumulation of mammoth skulls and tusks, tablets covered with carvings, and a female figurine of ivory. The fauna consisted almost exclusively of mammoth. The excavations were conducted by K. M. Polikarpovich in 1930, 1935, and 1936.

83. *Kurovo*.—On the right bank of the Sudost River stands this Upper Paleolithic station which was excavated by K. M. Polikarpovich in 1930. The fauna included mammoth, rhinoceros, horse, etc.

84. *Novye Bobovichi*.—In 1927 traces of an Upper Paleolithic station with worked flints and an accumulation of mammoth bones was found on the right bank of the Iput River, left tributary of the Sozh in the vicinity of Novozybkov.

85. *Iudinovo*.—This Upper Paleolithic site stands on the right

bank of the Sudost River, 14 kilometers north of Pogar, on the terrace above the spring floods on Kolkhoz "Pervomaiski." Preliminary excavations were made by K. M. Polikarpovich during 1934. Flint implements and mammoth bones were found in two places 200 m. away from both sides of the ravine.

86. *Suchkino*.—Traces of an Upper Paleolithic station on the left bank of the Seim River near Suchkino, 8 kilometers east of Rylsk, were investigated by S. N. Zamiatnin during 1930. The fauna consisted of mammoth, and the flints were insignificant, mainly flakes.

87. *Gankovo*.—A large quantity of mammoth bones and rhinoceros were found under the loess in fluvioglacial deposits covering the Riss moraine, 17 kilometers southwest of Smolensk on the watershed of the Ufinia River, the left tributary of the Dnieper. Only one worked flint came to light. This station has been investigated several times since 1910; small excavations were made in 1933 by K. M. Polikarpovich and G. A. Bonch-Osmolovskii.

88. *Skniatino*.—This Upper Paleolithic station is located on the dunes of the left bank of the Nerlia River near its confluence with the Volga. The large flint inventory is Azilian-Tardenoisian (Sviderskian Phase) in character. In 1937 P. N. Tretiakov, basing his study on pollen analysis, found it possible to attribute this site to the boreal phase.

89. *Kuibyshev*.—Mammoth bones were discovered during October 1920, while laying a sewer pipe on the Voznesenskii Spusk on the bank of the Volga. Investigation of this site by M. G. Matkin and A. I. Terenozhkin showed that bones lay at a depth of 3.2 m. under the fertile soil and the reddish-brown clay in a stratum of yellow sand above another arenaceous layer mixed with limestone pebbles. Near the mammoth bones were several small flint flakes.

90. *Mulinov Ostrov*.—Fossil bones were found on this island on the left bank of the Volga opposite the *gorodishche* between Tetiushi and Ulianovsk. Together with the remains of mammoth, Siberian rhinoceros, northern deer, elk, and bison there was found a human mandible. The Paleolithic character of the finds has not been established.

91. *Postnikov Ocrag*.—This Azilian (or even later) station stands at the mouth of the Postnikov ravine, on the northern outskirts of Kuibyshev, near the Postnikov site with the microlithic inventory. P. P. Efimenko and M. G. Matkin discovered on the slope of the bank a cultural stratum comprising microlithic flints and bone implements, including needles, together with faunal remains as yet not investigated.

92. *Undory*.—Fossil bones were found in a sand bar near the right

bank of the Volga on the island near Undory between Tetiushi and Ulianovsk. Together with the bones of mammoth and other animals there were also found two human calvaria, with the dark coloring characteristic of Pleistocene fauna. The age of these finds remains uncertain.

93. *Khriashchevskaiia Kosa*.—Fossil bones were found on the left bank of the Volga near Sengilei, farther downstream than this village. Since the end of the 1870's bones of mammoth, Siberian rhinoceros, primitive *Bos*, European bison, northern deer, elk, horse, and camel have been found here. According to P. A. Ososkov this accumulation of bones is the result of human activity since the long bones are often split and bear traces of utilization. In addition, there was found the frontal part of a human skull, which is, however, less deeply colored than the animal bones. The Paleolithic character of the finds remains tentative.

94. *I Ablonov Protok*.—Among bones found on the left bank of the Volga on the eroded sandy crest between the I Ablonov channel and the Sobachia Prorva channel near Tetiushi were those of mammoth, Siberian rhinoceros, horse, elk, noble deer, bison (*zubr*), and camel. Here also was found a human humerus, covered with the same almost black and brilliant patina as the animal bones. No Paleolithic flints were found.

95. *Ostrov*.—The first find of the Upper Paleolithic period in the Kama basin was made during September 1938 by M. V. Talitskii on the Chusovaia River near Ostrov and Gladenovo. The cultural stratum, 10.0 cm. thick, lies at a depth of 11.0 m. between the deposits covered by spring floods. The fauna included mammoth and northern deer, and apparently also the Siberian rhinoceros. The material consisted of flakes of flint, slate, and rock crystal, as well as knife-shaped laminae and small scrapers. Apparently it is here that occurred the accidental find of a mammoth rib fragment with the engraving in Paleolithic style, which first indicated the existence of this site.

96. *Buranovskaiia Peshchera*.—This cave is located 8 kilometers north of Ust-Katav on the bank of the Yuryuzan River in the Cheliabinsk *Oblast*. The cultural stratum, containing the crushed bones of animals, was discovered during 1938 at a depth of 2.0 m. in a yellow clay deposit by S. N. Bibikov. The fauna included *Bos*, horse, northern deer, Arctic fox, wolf, bear, rodents, birds, and fish. A few worked flints were found. This Upper Paleolithic station represents a temporary hunting camp.

97. *Kliuchevaia Peshchera*.—This cave, situated near No. 96, lies farther downstream on the Yuryuzan in the territory of the Bashkir

A.S.S.R. The cultural stratum can be clearly seen. The fauna consisted of Siberian rhinoceros, European bison, northern deer, Arctic fox, and other forms. The few worked flints and flakes were of dark Cretaceous flint unknown in this vicinity and only occurring about 120-150 kilometers distant. This Upper Paleolithic site, a type of hunting camp remote from permanent habitation, was excavated by S. N. Bibikov during 1938.

98. *Ust-Katav*.—During 1937 S. N. Bibikov found a considerable quantity of Pleistocene bones, including mammoth, in this cave near Ust-Katav railroad station in the southern Urals.

99. *Idelbaeva*.—Traces of this Upper Paleolithic site were found on the Guberla River northeast of Orsk in the Orenburg *Oblast*. In addition to flint implements, a large quantity of bones of two species of extinct *Bos*, horse, wolf, elk, northern deer, and dog were found.

100. *Lakedemonovka*.—Upper Paleolithic flints were found by V. A. Khokhlovkina during 1935 in the loess on the northern coast of the Sea of Azov.

UKRAINE¹⁸

101. *Amvrosievka*.—Of special interest was this Upper Paleolithic site, apparently Magdalenian, near Amvrosievka, Donets region, in the upper part of the Kazennaia ravine, on the right bank of the Krinka River and 2 kilometers distant. Discovered during 1935, this site was investigated in 1936 by the Museum of the Study of the Region in Stalino. Many worked flints were found on the gully slopes over an area of 6 hectares. The finds resemble the flint inventory of Kostenki II and III, Eliseevichi, and the Magdalenian sites along the left bank of the Dniester. The predominant tools were burins. There were also a large quantity of nuclei, indicating that this was an atelier. The finds were not concentrated on some particular level, but could be found from the surface to a depth of 1.25 m. into the loesslike loam. Probably to some later period belong the large campfire and the accumulation of cultural remains, mainly bones of the European bison (*Bison priscus*), no less than 300 animals being scattered over 40 square meters of the excavation. Flint inventories here differ from those mentioned above in the absence of

¹⁸ The following sites have been listed: Donbas (No. 101), northern Donets (Nos. 102-108), the middle Dnieper (Nos. 109-124), the basin of Desna (Nos. 125-138), the basin of Sula (Nos. 139-143), Seim (No. 144), the basin of Pripet (Nos. 145-147), the neighborhood of Odessa (No. 148), southern Bug (No. 149), Dniester (Nos. 150-164), and the neighborhood of Melitopol (No. 165).

burins. Bone points, spindle-shaped, similar to those from Veselogore were also found.

102. *Afrikanova Melnitsa*.—Traces of an apparently Upper Paleolithic site were found near Rogalik-IAkimovskaia at the confluence of the Evsug River and the northern Donets. This site is located on the slope of the high right bank of the Evsug near the mill. The worked flints do not lie deep. According to S. A. Loktiushev, the finds consist of objects similar to those found in Krinichnaia ravine, including burins, scrapers, and knife-shaped laminae.

103. *Beregovaia*.—In the vicinity of Rogalik farm (see No. 106) in the midstream of Evsug River near its confluence with the Donets north of Voroshilovgrad [formerly Lugansk], several flint implements, including two small round scrapers, were found. This station apparently represents the same period [Azilian] as that of Rogalik-IAkimovskaia. (See No. 106.)

104. *Veselogore*.—On a sand bar on the right bank of the Donets, 15 kilometers from Voroshilovgrad, near this village was found accidentally a bone javelin-head of Magdalenian type associated with the bones of mammoth, rhinoceros, *Bos*, horse, etc.

105. *Krinichnaia Balka*.—This Upper Paleolithic station, investigated in 1936, stands on the slope of the high right bank of the river Evsug near its confluence with the northern Donets. At a point 360 m. southwest of the station of Rogalik-IAkimovskaia (No. 106) were found during 1936 burins, scrapers, knife-shaped laminae, nuclei, and other implements of Rogalik type.

106. *Rogalik-IAkimovskaia*.—This typologically Azilian site near Rogalik farm lies on the high right bank of the Evsug River at its confluence with the northern Donets, 35 kilometers northeast of Voroshilovgrad [formerly Lugansk]. This station, discovered in 1926 by S. A. Loktiushev, was investigated in 1927, 1928, 1933, and 1936. The cultural remains, located on the right slope of the IAKimovskaia ravine, lie mainly in sandy loam with a slight admixture of humus, at a depth of 1.86 m. The animal bones were mainly *Equus*, and there were some marine Mollusca. Among the flint tools, which resemble closely those found in the upper horizon of Borshevo II, were such true geometric forms as trapezoids.

107. *Sheishinova Balka*.—During 1936 traces of this Upper Paleolithic site were found at the confluence of the Evsug with the northern Donets in Sheishinova ravine near Rogalik farm. The flint implements, from a depth of 0.25-0.60 m., were similar to those from Rogalik-IAkimovskaia (No. 106).

108. *Shchurovka*.—Mammoth bones and several worked flints,

including angle burins and flakes, were found along the northern Donets near the village of Shehurov Rog, north of Iziun. Collected by A. S. Fedorovskii and N. V. Sibilev in 1923, the finds were deposited partly in Kharkov and partly in Iziun Museum.

109. *Bairachnaia*.—During 1935 in Bairachnaia ravine near Yamburg, Dnepropetrovsk *Oblast*, there were found typologically Paleolithic flints and an accumulation of Early Quaternary animal bones in a sandy clay deposit of the type of ancient ravine formations.

110. *Burty*.—The remains of an Upper Paleolithic station with flints and bones of fossil animals were found in Burty ravine near Studenitsa in the neighborhood of Kaney, in a stratum of ancient ravine alluvium.

111. *Dubovaia Balka*.—This Upper Paleolithic site, which yielded eight cultural levels, the lower strata of which may be attributed to the Magdalenian period, stands on the left bank of the Dnieper, south of the mouth of the Ploskaia Osokorivka River, opposite Lake Dubovoe in the Dnieper rapids, known as Nenasytets and Volnichskii. Discovered during 1931 by the Dnieprostroï Archeological Expedition and investigated the following years, this station is situated on the left slope of Dubovaia ravine. The cultural remains lay partly in diluvial loesslike clay and partly in the stratified alluvial sands of the second terrace above the flood plain of the Dnieper. Some of the eight cultural levels contained only hearths and animal bones. The fifth stratum was the richest. The bones of *Bos* were in the large majority, although *Equus* and *Lupus* were represented. There were also many bones of *Lepus*. No mammoth bones were found. Among flint implements points predominated. There were also bone tools and shell ornaments.

112. *Kaistrova Balka I*.—This Upper Paleolithic site on the left bank of the Dnieper, south of the mouth of the Ploskaia Osokorivka River, west of Dubovaia Balka (No. 111), in the vicinity of Dnieproges [formerly Dnieprostroï], was discovered and investigated during 1931 by the Dnieprostroï Archeological Expedition. The cultural remains, in the loess of the second terrace above the flood level were partly destroyed by the small gully merging with the ravine. The fauna includes the European bison and horse. The flint inventory is represented mainly by burins and scrapers. The material remains unpublished.

113. *Kaistrova Balka II*.—This is another Upper Paleolithic site in the same vicinity. The cultural remains lie in two adjoining spots in the loess on the right slope of Kaistrova Balka, higher than Kaistrova Balka I at the edge of the gully. The fauna includes the

European bison and horse. The flint inventory is represented mainly by burins and scrapers. Two bones awls were also found. The material has not been published.

114. *Kaistrova Balka III*.—Insignificant traces of a cultural stratum in the loesslike clay occur on the left slope of the Kaistrova Balka, slightly higher than Kaistrova Balka II. Traces of the European bison constituted the only faunal material found.

115. *Kaistrova Balka IV*.—A deposit with an accumulation of flints was found on the left slope of Kaistrova Balka. This stratum was stained red by infiltrations of iron oxides.

116. *Kirillovskaia*.—A Lower Magdalenian site was discovered in 1893 by V. V. Khvoiko on Kirillovskaia Street in Kiev. The lower horizon of several strata yielded an accumulation of large campfires and of bones and tusks of mammoth. This horizon lies on the surface of the clays at the base of the ancient terrace beneath 22.0 m. of post-glacial deposits. In addition to mammoth, woolly rhinoceros was occasionally found. Among the few flint implements manufactured from flakes, burins of accidental forms predominated. Khvoiko found in the same horizon the fragment of a mammoth tusk covered with stylized designs. This site was studied from 1893 to 1900.

117. *Kirillovskaia* (upper horizon).—Discovered by V. V. Khvoiko in 1897, this Upper Magdalenian station was investigated by him in 1897 and 1899. The cultural stratum, containing ashes and a few charred animal bones, lay at the base of grayish-green sands, at a depth of 11-16 m. The fauna included lion, wolverine, wolf, and doubtful finds of hyena and mammoth. The flint inventory consisted of many flakes and tools.

118. *Kovalskaia Balka* (Krivoi Rog).—A quantity of flint implements and flakes, as well as mammoth bones, were found about 3 kilometers from Krivoi Rog near the confluence of the Saksagan with the Ingul in Kovalskaia ravine 1.0-1.50 m. into the reddish clay. Discovered by A. N. Pol, this site has not been investigated systematically. The gully is filled with the refuse from the neighboring mine.

119. *Maiorka*.—This Upper Paleolithic (Magdalenian) station stands on the right bank of the Dnieper, farther downstream than Yamburg and Voloskoe, near Maiorka ravine. Found and investigated by I. F. Levitskii during 1932, the cultural remains lay under the thick loess at two points: at the mouth of Maiorka ravine at a depth of 3.6 m.; and higher than its mouth, at a depth of 2.5 m. on the bank of the Dnieper, together with the bones of *Bos*. A few implements were unearthed.

120. *Osokorivka*.—This Upper Paleolithic site on the left bank

of the Dnieper, near the Dnieper Dam, is situated at the mouth of Ploskaia Osokorivka ravine on the second loess terrace. Several cultural horizons were discovered in 1931 and investigated by I. F. Levitskii during 1932. The lower stratum lies at a depth of 5.0 m. at the base of the alluvio-diluvial deposits and apparently belongs to the Magdalenian period. The three upper horizons, at a depth of 3.5 m. in the alluvio-diluvial deposit and 2.0-2.5 m. in the loesslike clay, are probably Azilian. The fauna included bison, horse, mammoth, rhinoceros, beaver, etc. The flint inventory has not been published. Some indications of the dwellings were found.

121. *Protasov I.Ar.*—Traces of the Upper Paleolithic site were found near the railroad station in Kiev. The finds were made at the beginning of the 1800's during construction work 16.0 m. under the loess. No further studies have been made.

122. *Selishche.*—In 1900 Paleolithic flint implements and associated fauna were discovered by N. I. Krishtafovich near Kanev, on the right bank of the Dnieper. The flints and fauna lay under conditions similar to those at Kirillovskaia (No. 116), where they were found under the thick loess and sand deposits overlying moraine clays.

123. *Skalka.*—In 1922 bones of mammoth and one flint tablet were found near Skalka *gorodishche* in the Kremenchug district.

124. *Yamburg.*—This Upper Paleolithic site stands on the right bank of the Dnieper at the mouth of the Sura River. Discovered and investigated by I. F. Levitskii in 1932, it is situated on the third terrace, common for both the Dnieper and Sura Rivers. The first horizon of the cultural remains lies in the loess clay at a depth of 1.5 m. Levitskii identified nine horizons, which are attributed to the Upper Magdalenian period.

125. *Voronozh.*—This Paleolithic site was found near Glukhov in the Chernigov region. The flints, collected some years ago by Abramov, are deposited in the Hermitage Museum, Leningrad.

126. *Devtiarcvo.*—An accumulation of split mammoth bones was discovered in this village in the Novgorod-Seversk district while fencing the church.

127. *Mezin.*—This Paleolithic site, which stands on the right bank of the Desna River downstream from Novgorod-Seversk, belongs presumably to the end of the Solutrean period. It is situated on the left slope of the Mezin ravine not far from its merging with the Desna Valley. In spite of long years of excavation the character of the habitation remains unclear. As a result of excavations during 1909 a dwelling in the form of shallow dugouts may have existed. Flint and bone implements were richly represented. Included in the fauna

were mammoth, rhinoceros, northern deer, horse, Arctic fox, wolverine, and others. Of especial interest were the shells originating near the Black Sea. Mezin was discovered by F. K. Volkov in 1908, investigated by P. P. Efimenko in 1909, by L. E. Chikalenko in 1912-1914, by B. G. Krizhanovskii in 1916, and by M. IA. Rudinskii in 1930.

128. *Novgorod-Seversk*.—This Upper Paleolithic site lies on the bank of the Desna River. The cultural deposits, partly beneath crumbled limestone, were mainly destroyed by quarrying. Many remains of the Pleistocene fauna, including mammoth, northern deer, Arctic fox, and lemming were excavated, associated with flints and worked bones. Among important objects were three gigantoliths, pickax-shaped tools, 0.45 m. long and weighing about 8.0 kilograms, of dark, Cretaceous flint. Found and excavated by I. G. Pidoplichka during April 1936, this site was also investigated in collaboration with M. V. Voevodskii and P. I. Boriskovskii during 1937-1938.

129. *Pushkari I*.—This site, attributed to an early phase of the Upper Paleolithic, stands on the right bank of the Desna River, 20 kilometers north of Novgorod-Seversk. Discovered by P. I. Boriskovskii in 1932, it was partly investigated by him in 1933 and during 1937-1938. The cultural stratum, at a depth of 1.0 m., yielded many flints including points, scrapers, large retouched laminae, and other forms. The faunal remains, including mammoth, Arctic fox, and wolf, were badly preserved.

130-134. *Pushkari II-VI*.—Near this village I. G. Pidoplichka and M. V. Voevodskii discovered several more Upper Paleolithic sites.

135. *Pushkari VII* (Pokrovshchina).—This station, presumably belonging to the end of the Upper Paleolithic, was discovered and investigated during 1938 by M. V. Voevodskii. It is situated near Pushkari, 315 kilometers from the bank of Desna River. The cultural stratum, comprising the accumulation of flints as rounded boulders, flakes, and some finished tools, lay 1.6 m. above the bottom of the gully.

136. *Chulatovo I*.—Discovered and investigated by I. G. Pidoplichka during 1935, this Upper Paleolithic site stands on the right bank of the Desna, 8 kilometers south of Novgorod-Seversk. Quarrying for chalk in the Kreidiani Maidan destroyed the greater part of the site. The cultural stratum stands 25.0 m. above river level. The fauna was represented by the mammoth, northern deer, horse, Arctic fox, wolverine, and lemming. Part of a human calvarium with traces of sawing¹⁹ were found associated with many flint implements typical

¹⁹ Cf. similar marks on Le Placard calvarium. (H. F.)

for the Lower Magdalenian of eastern Europe; these included mainly chisels, some scrapers, and fragments of bone implements.

137. *Chulatozvo II* (Raboehii Rog).—This Upper Magdalenian site, 1 kilometer from Chulatozvo I, had been partly destroyed by erosion. The cultural stratum was 3.5 m. deep. Some localities showed the manufacturing process of bone tools. The majority of the stone implements were burins, although some nuclei were found. Among the fauna were the mammoth and northern deer. This site, discovered during 1936, was investigated by M. V. Voevodskii in 1937 and 1938.

138. *Iukhnoza*.—In the Novgorod-Seversk district near this village were found bones of mammoth and some flint flakes.

139. *Vazovka*.—A chance find of the lower jaw of a mammoth and Paleolithic flint implements, eroded from the ancient clay deposits in the ravine, occurred near this village on the Sula River in the vicinity of Lubny in the Poltava region.

140. *Gai*.—Bones of fossil animals together with crude flint flakes were discovered near Gai farm, Romny district. The finds were deposited in Romny Museum.

141. *Gontsy*.—This Magdalenian site was located on the right bank of the Udai River near this village. Discovered and first excavated by F. I. Kaminskii in 1873, it was investigated by the staff of Poltava Museum during 1914-1915, and by I. F. Levitskii together with A. I. A. Briusov and I. G. Pidoplichka in 1935. The Paleolithic remains lay under 3.0-3.5 m. of loess on the edge of the sandy clay alluvium, of which the terrace consists. Mammoth bones were probably associated with the dugouts. In addition, there were also northern deer, hare, etc. The flint implements were small, mainly burins and scrapers. A few bone implements, including a perforated needle, were unearthed.

142. *Zhuravka*.—Standing on the left bank of the Udai River, a right tributary of the Sula, not far from Priluki, was this Azilian station on the alluvio-diluvial deposits of the second loess horizon of the lower terrace. Characteristic were the many bones of rodents (*Marmota bobak* Müll., *Citellus rufescens* K., etc.) and of the flint inventory of Epipaleolithic type. More ancient horizons of the same terrace yielded bones of mammoth. Zhuravka was investigated by an expedition from the Ukrainian Academy of Sciences [U.N.U., later U.A.N.] during 1927-1929.

143. *Sergacevka*.—During 1921 bones of mammoth and a flint lamina were collected in a ravine on the right bank of the Khorol, tributary of the Psel River.

144. *Shapozalovka*.—Bones of mammoth and some small flint laminae were found in the basin of the Seim River by N. D. Zubok-Mokievskii during 1879 on the shore of the lake in a steep escarpment, at the depth of 2.0 m.

145. *Dovginichi*.—In 1929 I. F. Levitskii found traces of this Upper Paleolithic station on the left bank of the Uzh River, a right tributary of the Pripet, near Ovruch.

146. *Iskorost*.—This Upper Paleolithic station stands near the rocky bank of the Uzh River at a depth of 0.5-9.8 m. During the excavations by V. V. Khvoiko in 1911, there were discovered beneath the burial mounds a series of campfires, many worked flints, and a few bones. Khvoiko accumulated here a large number of nuclei and their flakes. This material has not been published.

147. *Kolodeznoe*.—During 1924 I. F. Levitskii reported the accidental finding of bones of horse, mammoth, and other forms in a quarry along the Slucha River at the mouth of its tributary, the Tiukhterevka. The confirmatory excavations by S. Gamchenko in 1926 produced no positive results. The engraved bones published by Levitskii remain of doubtful character.

148. *Nerubaiskoe*.—Quaternary bones, including mammoth, rhinoceros, cave bear, deer, *Bos*, antelope, camel, and horse, were found near Odessa. N. I. Krishtafovich states that during his visit in 1904 he did not discover any worked flints.

149. *Semenki*.—This Upper Paleolithic site stands on the right bank of the southern Bug River near this village in Bratslav district. During 1931 K. M. Polikarpovich found flint implements and animal bones, among them the northern deer and the horse. The fauna has not yet been completely determined.

150. *Bagovitsy*.—An Upper Paleolithic site was located near Kamenets-Podolsk on the bank of the Dniester. The surface finds have not yet been described.

151. *Vrublevtsy*.—This station, situated not far from the Dniester along the Ternovaia River near Kamenets-Podolsk, was first identified in 1881 by V. B. Antonovich. Typologically Lower Magdalenian flints were excavated from the diluvial clay during 1927.

152. *Kalius*.—During 1927 typologically Magdalenian flints were found near this village on the left bank of the Dniester on the plateau near the Kalius River.

153, 154. *Kitai-Gorod I and II*.—Traces of the Upper Paleolithic sites were found on the right bank of the Ternovaia River, a left tributary of the Dniester, near Kamenets-Podolsk. The material has not been fully described.

155, 156. *Kolachkovtsy I and II*.—Traces of these two Upper Paleolithic sites were found on the right bank of the Studenitsa, a left tributary of the Dniester. The material, which was obtained during 1928, has not been described.

157. *Krivchik*.—A quantity of flint implements were collected at the entrance to the caves situated on the bank of the Dniester near Krivchik at the mouth of the Schusenka River. No further data are available.

158. *Kuzheleva*.—Traces of a site were located on the Ushitsa River, a left tributary of the Dniester near Bolshaia Kuzheleva. No further data are available.

159. *Nagoriany*.—Large stone implements crudely fashioned by percussion flaking were found in this cave situated on the left bank of the Dniester near the Ledava River. The material has not been described.

160. Near the caves situated not far from the Dniester on the left bank of the Smotrich River between Nechin and Zaluch were found stone tools. The material has not been described.

161. *Ozarinty*.—Several flints and one fragment of mammoth bone with a representation of this animal on it were found during 1912 near this village in the neighborhood of Kamenets-Podolsk in the talweg of the Borshchevetski IAr ravine. The Paleolithic origin of the finds remains doubtful.

162. *Sokol*.—Traces of this Paleolithic site were found on the left bank of the Dniester near this village in the neighborhood of Kamenets-Podolsk. The material has not been described.

163. *Studenitsa*.—This Magdalenian site is situated on the Belaia Gora overlooking the Dniester near the juncture of the Studenitsa River. Paleolithic flints were collected here, on the slopes of this mountain and in its cave, as early as 1883 by V. B. Antonovich. A considerable number of worked flints were found here during 1927.

164. *Ushitsa*.—During 1927 a few typologically Magdalenian flints were found on the surface at this site on the plateau between the Dniester and Ushitsa Rivers.

165. *Kamennyi Kurgan*.—This sandy hill stands on the right bank of the Molochnaia River near Terpene in the Melitopol district, Dnepropetrovsk region. Many engravings were found on the grotto walls formed of sandstone plates. According to O. N. Bader, some of them belong to the Epipaleolithic and even to the Upper Paleolithic periods.

TERRITORY OF THE B.S.S.R.²⁰

166. *Berdysz.*—This Solutrean site stands in Kolodezhki ravine on the right bank of the Sozh River near this village in the Checherskii district. The cultural remains lie in the sands at a depth of 5.0-6.0 m. The large quantity of mammoth bones were mainly unearthed. In addition, the fauna was represented by the horse, *Bos*, cave bear, Arctic fox, etc. These excavations were conducted during 1926-1929. The site was discovered by K. M. Polikarpovich and investigated by him, by S. N. Zamiatnin, and others. In 1929 there was discovered a pit, 3.0 m. long and 1.5 m. deep, filled with the remains of a dugout. Considerable excavations were made by Polikarpovich during 1938.

167. *Kleievichi.*—This site stands on the right bank of the Beseda River, a left tributary of the Sozh, near this village in the Kostiuukovich district. The finds included a small quantity of mammoth and horse bones together with flints (possibly of natural origin) in the sands of the upper terrace, at about the spring high-level mark. Studies were made here by K. M. Polikarpovich in 1919, 1930, and 1934.

168. *IUrovichi.*—This Upper Paleolithic site stands on the left bank of the Pripet on the second terrace above the spring high-level mark at the mouth of the ravine near this small town. A few worked flints associated with mammoth and horse bones were found in sands lying about 25.0 m. above the river level.

CRIMEA²¹

169. *Adzhi-Koba.*—The upper horizon of this cave contained flints of Upper Paleolithic type (see No. 22) similar to those from Siuren I. Above lay a stratum containing implements of microlithic type, excavated by A. S. Moiseev.

170. *At-Bash.*—This Tardenoisian site lies beneath the rock called At-Bash on the Ai-Petri IAila about 200 m. above sea level on the IAila precipice facing the sea near Siemiz. Investigated during 1927 by B. S. Zhukov and O. N. Bader, the cultural stratum, mostly eroded, lay at a depth of 40-60 cm. below the surface. In the center stood a hearth, surrounded by stone plates 2.5 m. in diameter. The inventory included flints of Tardenoisian type and single bones of deer and boar. The excavators also found fragments of slightly fired pottery, which possibly has no real connection with the Tardenoisian stratum.

²⁰ The following areas have been listed: Sozh Valley (Nos. 166, 167), and Pripet Valley (No. 168).

²¹ Nos. 169-188.

171. *Balin-Kosh*.—This Tardenoisian site is located in the Ai-Petri IAila near Bedene-Khyr Mountain and the Balin-Kosh area. Microlithic flint implements were found here by E. I. Visniovskaia and others. T. F. Gelakh found pebbles with an engraved pattern, resembling the painted pebbles (*galets coloriés*) of Mas d'Azil in the Ariège District of France.

172. *Buran-Kaia*.—This cave containing Azilian flints, animal bones, and shells of edible mollusks, stands on the right bank of the Borulcha River near Kainaut, in the Karasubazar Raion. Discovered by O. N. Bader in 1935, Buran-Kaia was investigated by him during 1936.

173. *Dzhelau-Bash*.—This open-air Tardenoisian site, in the area known as Dzhelau-Bash or Damchi-Kaia on the Chatyr-Dagh, was discovered and investigated by O. N. Bader in 1930. There were two cultural horizons: in the lower were found geometric microliths; in the upper, microliths with pottery.

174. *Zamil-Koba I*.—This cave, containing Azilian-Tardenoisian remains, was discovered during 1935 near Cherkez-Kermen by D. A. Krainov. The finds were in the lower cultural stratum.

175. *Zamil-Koba II*.—This cave with Tardenoisian remains stands next to Zamil-Koba I. It was discovered and investigated by D. A. Krainov in 1937. The flints were excavated from the lower cultural stratum.

176. *Kachinskii*.—This rock shelter with Upper Paleolithic remains stands above the Kacha River near Pychkhi village close to Bakhchisarai. Discovered by K. S. Merezhkovskii in 1879, it was investigated by him during 1879-1880. He found stone tools and some child's bones. According to G. A. Bonch-Osmolovskii this is a Magdalenian site.

177. *Kizil-Koba*.—This Tardenoisian atelier site stands on the slope of the Dolgorukov IAila near Kizil-Koba village close to Simferopol. During 1879-1880 K. S. Merezhkovskii found a large quantity of flint tools, nuclei, and flakes in the dark brown clay directly beneath the humus, relatively near to the natural location of the flint.

178. *Kukrek*.—This Tardenoisian open-air station stands on the right bank of the Zuia River, 5 kilometers south of Kiik-Koba (see No. 24). Discovered by G. A. Bonch-Osmolovskii in 1926, Kukrek was investigated by him during 1926-1927. The lower stratum of the site, which lay at a depth of 1.5 m. beneath the diluvial strata of clay and gravel, yielded prismatic nuclei, round scrapers, burins, and a quantity of microliths. The upper stratum, at a depth of 0.5 m., was poor in finds but contained typical trapezoids and segments. There

were few remnants of bones and hearths. The fauna included wolf, wild boar, deer, and hare. The flora of the site was characterized by the presence of *Quercus*.

179. *Murzak-Koba*.—This Tardenoisian cave, situated on the left bank of the Chernaia River in Boklu-dere gorge near Balaclava, was discovered and investigated by S. N. Bibikov and E. V. Zhirov in 1936. The cultural deposits yielded the characteristic flint inventory and bone tools including awls, a needle, and a double-barbed harpoon. Among fauna were deer, roe deer, wild boar, bear, fox, domesticated dog, badger, hare, fish bones, and a large quantity of snails (*Helix vulgaris*). In addition, here was also found the double burial²² of the Tardenoisian period. Excavations by S. N. Bibikov during 1938 revealed Upper Paleolithic strata near bedrock.

180. *Siuren I*.—A rock shelter, possibly Aurignacian, stands on the right bank of the Belbek River, higher than Biiuk-Siuren. 13 kilometers southwest of Bakhchisarai. Here there were three cultural horizons with flint implements, similar to those of Aurignacian sites. In addition, especially in the lower stratum, were found Mousterian tools including small axes, points, scrapers, and some bone implements. The fauna included the mammoth, cave hyena, northern deer, Arctic fox, white hare, rodents, northern birds (white grouse), and remains of fish. A study of the charcoal shows the boreal character of the vegetation. This site, discovered by K. S. Merezhkovskii in 1879, was investigated by him during 1879-1880, and later by G. A. Bonch-Osmolovskii in 1926-1929.

181. *Siuren II*.—This Late Azilian (Sviderskian Phase) rock shelter stands next to Siuren I. Discovered by K. S. Merezhkovskii in 1879, it was investigated by him during 1879-1880 and later G. A. Bonch-Osmolovskii in 1924 and 1926. The cultural stratum lies at a depth of 0.75 m. between limestone fragments. Near the entrance this stratum becomes about 4.0 m. deeper. The typical flint inventory includes well-preserved arrowheads of leaf-shaped form. The fauna has a contemporary character but with some Pleistocene species including cave lion and large deer. Here were also the first finds of the domesticated dog. A study of the charcoal from the hearth stratum revealed only aspen.

182. *Fatma-Koba*.—This Azilian-Tardenoisian rock shelter stands on the right bank of the Kubalar-Su in the Baidar Valley of the Balaclava district near Urkust. Discovered by S. A. Trusov and

²² A cast of one of the skulls is in the Chicago Natural History Museum. This was received during 1945 as a gift from IAE, Leningrad, where the original is on exhibition. See footnote 10. (H. F.)

S. N. Bibikov in 1927, it was investigated by G. A. Bonch-Osmolovskii in 1927. The lower cultural stratum belongs to the Azilian, the upper strata to the Tardenoisian period. In the latter were discovered the burials. The fauna, which was similar in all horizons, included wild boar, deer, wild donkey, horse, saiga, wolf, fox, hare, badger, cave lion, lynx, domesticated dog, and rodents. In the Tardenoisian levels maple and rowanberry were identified.

183. *Chatyr-Dagh*.—Traces of Paleolithic occupation were found in the cave of the Chatyr-Dagh, discovered by K. S. Merezhkovskii in 1879 and investigated by him during 1879-1880. In Bin-bash-Koba cave in the stratum of red clay were found remnants of hearths, bone breccia, and flint and bone implements. In Suuk-Koba cave in the same kind of stratum at a depth of about 1.50 m. were discovered traces of a hearth, crushed bones, and stone tools of Siurenian type. The caves of Chatyr-Dagh were investigated in 1930 by O. N. Bader, who excavated about 3.0 m. of the cultural deposits.

184. *Cherkez-Kermen*.—Two Azilian caves were discovered near this village by K. S. Merezhkovskii in 1880. The finds included stone and bone implements, and the bone of a dolphin. It is probable that these caves are contemporaneous with Zamil-Koba I and II.

185. *Shan-Koba*.—This Azilian-Tardenoisian rock shelter, on the right slope of Kubaral-dere ravine near Urkust in the Baidar Valley, found by S. A. Trusov and S. N. Bibikov in 1927, was investigated by G. A. Bonch-Osmolovskii during 1927-1928 and by Bibikov in 1935-1936. There were found altogether six cultural horizons, five Epipaleolithic with traces of hearths, microlithic flints, bone compressors and needles, borers and points, implements with inserts, and a large quantity of shells of *Helix vulgaris*. The second and third cultural strata belong to the Tardenoisian or Azilian transition period. The fauna included deer, horse, boar, beaver, hare, wolf, fox, lynx, dog, etc. Represented in the flora were birch, mountain-ash, buckthorn, and juniper in the lower strata, and maple and buckthorn in the upper levels.

186. *Shpan-Koba*.—This Tardenoisian rock shelter near Tau-Kipchak was discovered and investigated in 1925 by G. A. Bonch-Osmolovskii and by O. N. Bader a decade later.

187. *IUsuf-Koba I*.—During 1936 E. V. Zhirov discovered a Tardenoisian rock shelter on the eastern slope of Caye Lang near Biuk-Muskomia in the Balaclava district. The cultural stratum yielded crushed animal bones and an accumulation of the shells of *Helix vulgaris*.

188. *I.ila*.—Many Epipaleolithic stations were found on the slopes

of the IAila Plateau, beginning with Chatyr-Dagh and as far as Point Liaspi. One of these sites, Kizil-Koba on the Dolgorukov IAila, was discovered and investigated in 1879 by K. S. Merezhkovskii. In 1913 N. N. Klepnin and N. I. Dubrovskii discovered on the IAila three Tardenoisian sites. Later A. S. Moiseev discovered about 30 more sites. The systematic investigations of the Ai-Petri IAila and Chatyr-Dagh, begun in 1927, were conducted by B. S. Zhukov, O. N. Bader, E. I. Visniovskaia, and others. S. I. Zabnin and Visniovskaia also discovered several sites. In the Feodosia region investigations were conducted by P. P. Zablotskii, N. S. Barsamov, and Bader. Also examined were the sites of Kizil-Koba by Merezhkovskii, At-Bash by Zhukov and Bader, Balin-Kosh by Zhukov, Bader, Gelakh, and others, and the sites of the Chatyr-Dagh, Dzhelau-Bash, Uzun-Koba, Kenavuz-Koba, and others by Bader. Microlithic flint implements were found at all these sites, but other finds, such as a stone lamp and pebbles with incisions, occurred at only a single site.

CAVES IN THE CAUCASUS ²³

189. *Bartashvili Peshchera*.—This Upper Paleolithic cave near Kutaisi, not far from Virchow cave, was discovered and investigated by the expedition led by P. P. Schmidt and L. Kozlovskii in 1914. The results remain unpublished.

190. *Bucle-Klde*.—This Upper Paleolithic cave on the Kvirila River near Chiaturi was discovered by S. A. Krukovskii in 1918 and investigated by S. N. Zamiatnin in 1934.

191. *Virchow Peshchera*.—This Upper Paleolithic cave near Motsameti close to Kutaisi was discovered and investigated by the expedition led by P. P. Schmidt and L. Kozlovskii in 1914 and by G. K. Nioradze in 1936. The flint inventory is characterized by the nuclei-shaped tools and by the large quantity of small laminae with blunt edges, resembling geometric microliths. Represented in the fauna were the strongly mineralized bones of the cave bear.

192. *Gvardzhilas-Klde*.—This Azilian cave, which stands on the left bank of the Kvirila River near Rgani close to Chiaturi, was discovered and investigated by S. A. Krukovskii during 1916-1917. Among the many stone tools were a large quantity of geometric microliths, small crudely fashioned axes, and articles made of bone and horn including a harpoon of Azilian type. In the fauna were *Ursus arctos*, *Ursus spelaeus*, *Bison bonasus*, and *Bos taurus*.

193. *Darkveti*.—Traces of an Upper Paleolithic site were found

²³ Imeretia (Nos. 189-199), Abkhazia (No. 200), and Adler Raion (No. 201).

by S. N. Zamiatnin during 1936 in this cave near Darkveti railroad station on the right bank of the Kvirila River.

194. *Devis-Khveli*.—This Upper Paleolithic cave, located on the right bank of the Chkherimela River in Khandebi quarry between the Dzeruly railroad station and Kharaguly, was discovered by G. K. Nioradze in 1926 and investigated by him during 1926-1928. Many flint flakes and implements were unearthed. Bone tools, mainly awls and compressors, were present but were not numerous. According to V. I. Gromov and M. V. Pavlova, the fauna consisted of wild boar, wild goat, and bear, all of which were presumably the main objects of the chase. A fragment of a human mandible and two molars were excavated.

195. *Mgvimevi*.—Flint implements and other traces of a cultural stratum of the Upper Paleolithic period were discovered by S. N. Zamiatnin in 1934 near Mgvimevi, 1 kilometer north of Chiaturi on the right bank of the Kvirila River. A row of linear geometric signs was recorded on the surface of the rock along the edge of Rock Shelter No. 5.

196. *Taro-Klde*.—This Aurignacian cave site near Shukrut on the upper course of the Kvirila in the neighborhood of Chiaturi was discovered and investigated by S. A. Krukovskii in 1918. The cultural deposits consist of a flint inventory of Upper Paleolithic type mixed with Mousterian forms and also of a large quantity of bone points.

197. *Uzarova Peshchera*.—This Upper Paleolithic cave, which stands on the left bank of the Krasnaia River (Tskhali-Tsiteli) near Kutaisi and not far from Virchow cave, was investigated in 1914 by an expedition led by P. P. Schmidt and L. Kozlovskii.

198. *Khergulis-Klde*.—This Aurignacian cave is located at Vachevi near Chiaturi on the right bank of the Kvirila. The finds consisted of tools of Upper Paleolithic type and a quantity of surviving Mousterian forms, which, however, were characterized by the perfection of their retouch. The fauna included bear, wild horse, and *Bos*.

199. *Tsirkhveli*.—Traces of an Upper Paleolithic site resembling Gvardzhilas-Klde (No. 192) were found in this cave near Tsirkhveli and the Kvirila River not far from Chiaturi. Tsirkhveli was discovered by S. N. Zamiatnin in 1934.

200. *Planta*.—During 1936 L. N. Solovey found this cave near the confluence of the Amtkel and Kodor Rivers. On the scree slopes and above bedrock were flint implements and flakes of Tardenoisian type, including many geometric forms, associated with animal bones.

201. *Navalishenskaia Peshchera*.—The upper part of this cave in the Adler Raion (see No. 33) yielded Upper Paleolithic remains.

OPEN-AIR SITES IN THE CAUCASUS²⁴

202. *Dafnari*.—Several Upper Paleolithic implements were found by A. N. Kalandadze in 1926 on the top of the uplands next to the outlet of the red Turonian flint, near this village 3 kilometers from Lapchkhuti.

203. *Liia*.—Traces of an Upper Paleolithic site were located during 1936 by A. N. Kalandadze on the ancient terrace of the Ingur River, 1.5 kilometers from the Zugdidi-Dzhvari highway. Near the cemetery, at a depth of 0.8-to 1.2 m., were flint nuclei, scrapers, burins, and laminae. The site was destroyed during the construction of this highway.

204. *Odishi*.—This Upper Paleolithic site, which lies in this village in the Zugdidi *Raion*, was discovered by A. N. Kalandadze during 1936. A large quantity of flint implements including scrapers, burins, nuclei, laminae, and geometric blades were found. In addition, some Neolithic implements such as arrowheads and grinding stones were unearthed in the unplowed part of the small plateau which goes down to the valley of the Dzhumi River. On the Zugdidi-Odishi highway in the vicinity of the Odishi Cooperative were found a few patinated flint tools.

205. *Rukhi II*.—Traces of an Upper Paleolithic site were discovered by A. N. Kalandadze in 1936 near the school of this village, 6 kilometers from Zugdidi. The nuclear burins, elaborate scrapers, laminae with incisions, knife-shaped tablets, and three points covered with milky patina were accumulated on the surface.

206. *Supsa-Shroma*.—Traces of this Paleolithic site were discovered by A. N. Kalandadze on the Supsa-Shroma Highway in 1936. Here were found flakes and laminae; in front of the school near Dzharbenadze on the slope near the highway were two scrapers and laminae. At Motsviari on the right bank of the Sefa River flakes were collected.

207. *Kheti*.—Flint tools were found on the slopes of Urta Mountain by A. N. Kalandadze in 1936. Animal bones, fragments of a human calvarium, and several flint flakes were found on the small elevation. A large, deeply patined flake was collected at the foot of this slope opposite the former Latariia Estate. More to the west, in the escarpment of the brook in situ were two laminae. Traces of the Upper Paleolithic site can also be found on the left bank of the Munchii River, where the slope of Urta Mountain merges with the Kolkhida Valley near the railroad.

²⁴ Mingrelia (Nos. 202-208), Abkhazia (Nos. 209-214), and Sochi *Raion* (Nos. 215-216).

208. *Entseri*.—Traces of this Upper Paleolithic station were discovered by A. N. Kalandadze in 1936 on the left bank of the Ingur River in this village. The inventory included flint laminae, nuclei, scrapers, and multifaceted burins.

209. *Atap*.—Upper Paleolithic flints were collected near this village. (See No. 3.)

210. *Gali*.—Typologically Upper Paleolithic flints were found on the 80-m. terrace. (See No. 5.)

211. *Zakharovka*.—On the elevation over the ravine of the Amtkel River on the surface of the moraine were found Upper Paleolithic flints.

212. *Tabachnaia*.—Flints of Upper Paleolithic type were obtained at the Zonal Tobacco Station on the surface of the 100-m. terrace near Sukhumi. (See No. 11.)

213. *Tsebelda*.—Flints of Upper Paleolithic type were collected on the elevation near Tsebelda. (See No. 12.)

214. *I. Ashtukh*.—Upper Paleolithic flints were found near Sukhumi. (See No. 14.)

215. *Abazinka*.—Upper Paleolithic flints were collected on the left bank along the Matsesta River, 6 kilometers upstream from Old Matsesta.

216. *Semenovka*.—Upper Paleolithic implements were found on the street and estates of this village which stands beside the Matsesta River.

ASIATIC PART OF THE R.S.F.S.R.²⁵

217. *Nizhne-Yeniseiskaia*.—Among the collections made by Sergeev and Markov in 1933 on the right bank of the Biia River, about 12 kilometers from Biisk, were found on the dunes a quartzite *pièce écaillée* and a crude chip of Upper Paleolithic type.

218. *Srostki*.—Traces of this Paleolithic site, as expressed in the finds of crudely fashioned stone tools, mainly quartzite, were discovered in several neighboring locations on the side of the 50 m. terrace on the right bank of the Katun River, 30 kilometers from Biisk. The cultural remains lay at a depth of 1.10 m. in the loesslike sandy loam. The finds consisted of nuclei and tools made of small

²⁵ Western Siberia (Nos. 217-220), the basin of the Upper Yenisei (Nos. 221-255), the basin of the Angara (Nos. 256-277), the basin of the Lena (No. 278), Buriat-Mongolia (Nos. 279-290), Khabarovsk Krai (No. 291), and the Primorski [Maritime] Krai (No. 292).

See also Henry Field and Eugene Prostov, Results of Soviet Investigations in Siberia, 1940-1941. Amer. Anthropol., vol. 44, No. 3, pp. 388-396, 1942.

flakes resembling those from the Yenisei site (No. 217). The fauna, which was not rich, included horse and possibly deer.

219. *Tomsk*.—A temporary hunting site of the Upper Paleolithic period was discovered and investigated by N. F. Kashchenko in 1896 on the right bank of the Tom River in Tomsk. He found a skeleton of a young mammoth and traces of campfires and flint flakes 3.5 m. deep in the loesslike clay.

220. *Fominskoe*.—Traces of this site were found in 1911 by M. D. Kopytov on the right bank of the Ob River near this village in the vicinity of Biisk. Later finds were deposited in the Biisk Museum. The cultural remains, consisting of rather crudely fashioned points and massive flakes of quartzite similar to those found in Srostki, originated in the lowest terrace only 5.0 m. above river level.

221. *Aieshka*.—Flakes and a scraper of Paleolithic type as well as teeth and fragments of animal bones were found by G. Merhart in 1920 south of this village in the Novoselovo *Raion* on the slope of the first terrace above the Yenisei River.

222. *Anash* (Krasnoiarsk *Krai*).—Several crude stone tools, retouched flakes, and fragmentary bones of mammoth and deer were collected on the surface of the reddish-brown clay in the sandy ravine. These finds were made by G. P. Sosnovskii and M. P. Griaznov in 1923 near this village in the Krasnoiarsk region on the right bank of the Yenisei, 170 kilometers farther downstream than Minusinsk.

223. *Afontova Gora I*.—This Magdalenian site, at the foot of Afontova Mountain on the left bank of the Yenisei near Krasnoiarsk, stands on the slope behind the railroad station. During the preparations for the construction of two brick barns, I. T. Savenkov in 1894 found in the loess clay crushed bones of fossil animals including northern deer, mammoth, *Bos*, horse, and dog, stone and bone tools, and tusks of mammoths.

224. *Afontova II*.—This Paleolithic site near Krasnoiarsk, below the former IUdin Estate, was discovered during 1912. Systematic excavations were conducted by N. K. Auerbakh, V. I. Gromov, and G. P. Sosnovskii during 1923-1925. The cultural strata lay in the deposits of the 15- to 16-m. terrace of the Yenisei. The upper level lay in the sandy loess at a depth of 1.0-3.5 m., the lower stratum in the loessy clay and sandy soil 12.0 m. beneath the surface. Remains of dugouts were found in the lower horizon. The fauna consisted mainly of northern deer, Arctic fox, hare, mammoth, and dog. There were neither mammoth nor Arctic fox remains in the upper level. Together with the numerous stone tools were found bone implements

and also ornaments. In the lower level in trench No. 5 were discovered five human bones.

225. *Afontova III*.—This Paleolithic site, which stands near Krasnoïarsk in the neighborhood of the oil reservoirs, was discovered by I. T. Savenkov in 1914 and investigated by him with the assistance of N. K. Auerbakh in 1925 and 1930. The upper horizon lay at a depth of 0.9-1.5 m. beneath the present surface in the yellow loessy clay soil; the lower horizon, poorer in finds, lay at a depth of 2.0-3.2 m. The fauna of the lower horizon included mammoth, hare, horse, northern deer, and Arctic fox; the upper horizon yielded only the northern deer and *Bos*. Both horizons contained stone and bone implements.

226. *Afontova IV* (Ivanikhin Log).—Near Krasnoïarsk on the upper part of the slope of Afontova Mountain between Afontova II and Afontova III stands this site, discovered by I. T. Savenkov. The strata were similar to the upper horizon of Afontova II. Among fauna were *Bos* and the northern deer.

227. *Achinsk*.—In 1914, during railroad construction, split mammoth bones and charcoal, as well as stone implements, were found in the loessy loam near this town.

228. *Batni I*.—This Paleolithic site stands on the left bank of the Yenisei River, 150 kilometers downstream from Minusinsk, on the left bank of the Tashtyk River near its mouth. The cultural stratum, discovered in 1925, lay at a depth of 1.0 m. in the loessy loam of the spring-flooded terrace of the Yenisei. Stone and bone implements were found. In the fauna were the northern deer and *Bos primigenius*.

229. *Batni II*.—The cultural stratum of this Paleolithic site near this village lay in the loessy clay above the spring-flooded terrace of the Yenisei. Stone and bone tools were unearthed. Included in the fauna were *Bos primigenius*, saiga, deer, elk, mammoth, wolf, hare, and *Equus hemionus*.

230. *Batni III*.—This Paleolithic site, 1.5 kilometers north of this village at IArki, was discovered by I. T. Savenkov during the 1890's. Stone implements were also found here by G. Merhart, G. P. Sosnovskii, and others.

231. *Batoi*.—At this place, 35 kilometers north of Krasnoïarsk, were found the skull of *Cervus elaphus*, bearing traces of human workmanship, and one stone implement.

232. *Biriusa*.—This group of Paleolithic sites on the bank of the Yenisei, at the mouth of the Biriusa River, 50 kilometers upstream from Krasnoïarsk, was discovered by A. P. Elenov in 1890 and was investigated by him in 1891 and by N. K. Auerbakh and V. I. Gromov

in 1926 and 1927. In 1928 these sites were examined by G. F. Mirchink and V. I. Gromov in connection with the study of the terraces of the Yenisei. Biriusa I consisted of three Paleolithic strata lying on the spring-flooded terrace in 2.0 m. of yellow-grayish clay and sand. In the stratum representing the transition from the Paleolithic to the Early Neolithic were found stone implements including nuclei and flakes, and crushed bones of such animals as the large *Bos*, northern deer, horse, noble deer, mountain sheep, wolf, and hare. The upper horizon consisted of an accumulation of large stones and ashes. Here were found stone tools, as well as implements made of bone, such as needles and points. Included in the fauna were the northern deer, *Bos*, hare, mountain sheep, roe deer, and horse.

233. *Bugach*.—This site stands on the left bank of the Kacha River, a left tributary of the Yenisei near its confluence with the Bugach River, 1 kilometer northeast of Krasnoiarsk. Bugach was discovered by G. P. Sosnovskii in 1919 and investigated by him in 1923. The cultural stratum with hearths, flint implements, and flakes was found at a depth of 1.0 m. in the loessy clay on the first terrace, which is flooded during the spring high water. The fauna included the Arctic fox, northern deer, hare, and other forms.

234. *Buzunova*.—This group of Paleolithic sites is located on the terrace situated above spring high water on the right bank of the Yenisei, 55 kilometers downstream from Minusinsk. The cultural remains were discovered during 1920 at two points, one above the other below Buzunova. The stone tools and flakes and the fragments of a bone tip were found by G. P. Sosnovskii in 1923 in the hearth level at a depth of 5.5 m. in loessy clay on the right side of the confluence with the river gully. V. I. Gromov and N. K. Auerbakh accumulated new surface material in 1925 from the site above Buzunova.

235. *Voennyi Gorodok*.—This Paleolithic site on the left bank of the Yenisei, 4 kilometers downstream from Krasnoiarsk near the second Korovii Log, was discovered in 1911 by A. IA. Tugarinov and A. P. Ermolaev and investigated by G. P. Sosnovskii in 1919 and 1923 and by V. I. Gromov in 1928. The cultural stratum lies in the loessy clay sand deposits at depths of 2.0 and 4.0-6.0 m. Associated with the stone tools and flakes were implements made of horn and bone. Represented in the fauna were mammoth, northern deer, Arctic fox, wolf, and horse.

236. *Dolgova*.—Stone implements were found in 1885 by I. T. Savenkov at this new settlement near the Chernaia Sopka. Bones of

mammoth, rhinoceros, and other animals were found in the clay near the mill.

237. *Zykovo*.—A fragment of an antler of the northern deer, with incisions, was found by G. P. Sosnovskii in 1925 near Zykovo railroad station. He also found charcoal and animal bones in the loess of the ravine behind Puzyrevo.

238. *Izykh*.—I. T. Savenkov found a Paleolithic scraper on the dunes at the southeastern slope of Izykh Mountain on the right bank of the Abakan River.

239. *Kacha*.—This Paleolithic site, near the factory in the valley of the Kacha River, a right tributary of the Yenisei, was discovered by V. I. Gromov and N. K. Auerbakh in 1928.

240. *Kliuch Gremiachii*.—Traces of this site were located at the efflux of Gremiachii brook on the left bank of the Yenisei, 1.5 kilometers from the railroad bridge over the Yenisei. G. P. Sosnovskii found here in 1919 traces of charcoal, a stone scraper, a fragment of mammoth tusk, and bones of the northern deer and split tubular bones of animals in the loess at a depth of 1.25 m.

241. *Kokorevo I (Zabochka)*.—This site on the left bank of the Yenisei stands approximately 500 paces farther upstream than Kokorevo in the northern part of the Minusinsk Valley. Discovered by G. P. Sosnovskii and investigated by him in 1925 and 1928, the cultural stratum lies from 2.6 to 4.15 m. deep in the loesslike sandy loam, which covers the lowest terrace. Here were found four hearths surrounded by stones with the accumulation of cultural remains consisting of stone tools and flakes, a few fragments of bone implements, and crushed bones of such animals as the horse, noble deer, *Bos*, mountain sheep, wolf, and others. The charcoal found in the hearths originated from larch, fir, willow, pine, and birch.

242. *Kokorevo II (Telezhnyi Log)*.—This site, located on the left bank of the Yenisei near Kokorevo in the Telezhnyi ravine, was investigated by G. P. Sosnovskii in 1925 and 1928. The cultural stratum was discovered at a depth of 6.2 m. beneath a deposit of buried soil and loessy clay sand covering the lowest terrace. The finds consisted of stone tools, fragments of a few bone implements, charcoal (larch, willow, birch), and of split bones of animals including the mammoth, Arctic fox, northern deer, horse, wolf, hare, and marmot.

243. *Kokorevo III*.—This site, north of Kokorevo in the Kamennyi Log at its merging point with the Telezhnyi Log, was investigated by G. P. Sosnovskii in 1925 and 1928. The cultural stratum lies at a depth of about 1.6 m. in the clay sands of the ancient ravine on the

slope of the 40- to 50-meter terrace. The Paleolithic remains formed small, separate accumulations around the hearth. Among the finds were quartzite tools; crushed bones of northern deer, horse, hare, and wolf; and small pieces of charcoal from larch and fir.

244. *Kokorevo IV.*—This site, situated 2 kilometers farther downstream than Kokorevo in the Kipirnyi Log, was investigated by G. P. Sosnovskii in 1925 and 1928. The Paleolithic remains were in the loesslike sandy loam of the lowest terrace above flood level at a depth of 1.5-2.1 m. In addition to tools there were excavated the bones of animals, including the northern deer, noble deer, bison, and *Equus hemionus*.

245. *Korkino.*—A stone tool and a bone awl were found at the bottom of the ravine, the last one at Korkino on the left bank of the Yenisei River.

246. *Krasnoiarsk.*—During the construction of a brewery, bones of fossil animals with traces of human workmanship and typologically Paleolithic stone tools came to light. Similar discoveries were also made in another part of the city.

247. *Kubekovo.*—Quaternary animals bones, Paleolithic stone tools, and a deer antler with traces of human workmanship were found by N. K. Auerbakh and V. I. Gromov in Iankov Log and in the other ravines near Kubekovo on the left bank of the Yenisei, 23 kilometers upstream from Krasnoiarsk.

248. *Ladeiki.*—Traces of this Upper Paleolithic site were found near this village on the right bank of the Yenisei, 8 kilometers farther downstream from Krasnoiarsk, under the dunes and the pockets of loess among the pebbles. I. T. Savenkov found here in 1883 bones of a large *Bos* and tools of Paleolithic type at the edge of the lowest terrace. The excavations were continued by Baron Joseph de Baye in 1896, by G. Merhart in 1920, and by G. P. Sosnovskii in 1923.

249. *Lepeshkina* (Irdzha).—A group of Upper Paleolithic sites were located on the right bank of the Yenisei near this village, opposite Bateni pier. The first site, which was discovered by G. Merhart in 1920, comprised the material on the slope of Irdzha Mountain, the elevation surrounding the river valley. In 1923 G. P. Sosnovskii discovered in the deposits of eolian sands three hearths surrounded by bones of animals, including bison, stone tools and flakes. The second surface site, yielding stone tools, was found by Sosnovskii in 1923 on the bank of the Yenisei Canal upstream from the village. V. I. Gromov and G. F. Mirchink discovered a thick cultural stratum in 1927 near Lepeshkina.

250. *Pereselencheskii Punkt.*—This Paleolithic site stands on the

right bank of the Yenisei near the canal opposite Krasnoiarsk. The first finds here were made by Baron Joseph de Baye in 1896. The site was investigated by S. M. Sergeev in 1912 and G. P. Sosnovskii in 1923 and 1926. The cultural remains were discovered in the loess of the lowest terrace, where they had the character of patches. It is possible that these are the remains of dugouts. Included in the fauna were northern deer, horse, bison, cave lion, roe deer, rodents, and birds. Together with the stone tools and flakes were found bone tools, fragments of shells, and pieces of coloring matter.

251. *Tes.*—Crude stone implements were found by I. T. Savenkov in 1885 on the dunes near this village on the Tuba River.

252. *Uzunzhul.*—An antler of northern deer with traces of human workmanship, a scraper, and Quaternary animal bones including mammoth and rhinoceros were found in the auriferous gravel of the Uzunzhul River.

253. *Ulazy.*—Traces of this site farther upstream than Ulazy on the right bank of the Yenisei were investigated by G. P. Sosnovskii in 1923 and 1925. On the exposed clay sections he discovered bones of *Bos*, northern deer, and other animals, together with Paleolithic flakes and nuclei.

254. *Chasgol.*—I. T. Savenko found in the auriferous gravel of the Chasgol River at a depth of 4.0 m. a knife-shaped flake of greenstone.

255. *IAnova.*—A typologically Paleolithic stone implement was found by G. P. Sosnovskii in 1925 on the slope of the ravine. This discovery was made at a depth of 1.0 m. in the loess on the left bank of the Yenisei, 1.5 kilometers from this village and 5 kilometers from Novoselovo. In another part of this same ravine were found the jaw of a mammoth and flint flakes.

256. *Badai I.*—The remains of a site of the end of the Upper Paleolithic period were found on the left bank of the Belaia, a tributary of the Angara, near this village on the plowed land along the 40 m. terrace. The site is located in Gluboki ravine near the factory. M. M. Gerasimov accumulated here a large quantity of typical implements, mainly scrapers, small laminae and nuclei.

257. *Badai II.*—This site, which was destroyed by plowing, lay on the right bank of the Belaia River opposite this village.

258. *Buret* (Sukhaia Pad).—This Paleolithic site on the right bank of the Angara near Nizhniaia Buret was discovered by A. P. Okladnikov in 1936. Buret is situated on the slope of the second (15- to 20-m.) terrace above spring high water at the mouth of Sukhaia ravine in the loesslike loam. Among the bones identified were

mammoth, *Equus hemionus*, and northern deer. Together with flint tools were found some sculptures, including the figure of a woman carved from mammoth ivory. This site was excavated by Okladnikov during 1936-1937. The character of finds confirms that the site belongs to the group of more ancient Upper Paleolithic sites of the Angara, i.e., the Malta type.

259. *Verkholenskaia Gora*.—On this mountain near the Angara River and 3 kilometers from Irkutsk were found four Paleolithic stations: Zharnikova Pad, Goriunova Pad, Ubiennykh Pad, and Ushkanka Pad. The first, known under the name of Verkholenskaia Gora, is situated on the southwestern slope of the elevation between the Zharnikova and the Ubiennykh Pad. The cultural stratum was found by M. P. Ovchinnikov as early as 1897. The stone and bone tools and other remains of habitation lay at a depth of 1.5 m. in the loesslike loam. The fauna consisted of northern and noble deer, elk, *Equus hemionus*, *Bos*, dog, and wolf. The large-horned deer, rhinoceros, and mammoth, found by Ovchinnikov, originated apparently in the lower horizon. This site was investigated at different times from 1919-1928.

260. *Glazkovo*.—In 1897 M. P. Ovchinnikov found stone (flinty schist) tools similar to those from Verkholenskaia Gora, and Quaternary animal bones with traces of human workmanship in the loess on the left bank of the Angara in the suburb of Glazkovo opposite Irkutsk.

261. *Zaitsevo* (Kosoi Vzvoz).—This Upper Paleolithic site, which stands on the left bank of the Angara near Usole at the mouth of the Belaia River, was discovered by A. P. Okladnikov in 1934. The inventory consisted of large scraperlike tools of the same type as those found on Verkholenskaia Gora.

262. *Zvezdochka*.—According to A. P. Okladnikov, remains apparently belonging to the Paleolithic period were discovered on the left bank of the Angara, opposite Irkutsk, on the piece of land called "Zvezdochka" near the ferry.

263. *Irkutsk*.²⁶—Paleolithic remains are known from three sites within the city. The first is located on one of the hills along the Ushakovka River. Here in 1871, during construction of the Military Hospital, were found implements made from the tusk of a mammoth (including one with ornamentation), a perforated deer incisor, fragments and points of spherosiderite, and bones of mammoth, rhinoceros, northern deer, horse, *Bos*, and other animals. The second site, located

²⁶ In this area the work of the late B. E. Petri is conspicuously absent. (H. F.)

by M. P. Ovchinnikov, lay not far distant on the bank of the Ushakovka River in the suburb Rabochaia Sloboda. The third, according to A. P. Okladnikov, is in Pshenichnaia ravine.

264. *Kaiskaia Gora*.—M. M. Gerasimov discovered during 1924-1925 Paleolithic traces in the lower part of the loesslike sandy loam on the side of Kaiskaia Mountain at the juncture of the Irkut and Angara Rivers. The finds consisted of roughly fashioned stone tools and flakes, traces of charcoal, and crushed bones of animals, including horse, mammoth, *Bos*, northern deer, elk, rhinoceros, and birds, especially small birds of prey.

265. *Kamenolomnya*.—Here were found traces of an Upper Paleolithic workshop near the old quarry on the right bank of the Belaia opposite Malta.

266. *Kamen*.—Traces of a large Upper Paleolithic site (Badai type) were found on the plowed ground at the edge of the 40-m. terrace on the left bank of the Belaia near Malta. M. M. Gerasimov collected crude nuclei, laminae, and a large quantity of tools, mainly scrapers.

267. *Kova*.—Traces of this Paleolithic station were discovered on the Kova River, a left tributary of the Angara, by this village. The investigation conducted by A. P. Okladnikov in 1937 discovered at a depth of 0.6 m. the remains of campfires and mammoth bones in the loesslike loam.

268. *Malta* (Lower Horizon).—This Paleolithic site stands on the left bank of the Belaia, a left tributary of the Angara, 85 kilometers west of Irkutsk. Led there by local inhabitants, M. M. Gerasimov investigated Malta in 1928 and 1930, 1932, 1934, and 1937. In 1932 S. N. Zamiatnin also worked there, and G. P. Sosnovskii in 1934. The lower horizon, 35.0-75.0 cm. thick, lay in the loesslike sandy loam on the 18-m. terrace. Here were found traces of the surface dwellings and hearths of stone plates. Below the cultural stratum a child's burial was found. Together with numerous stone tools were about 600 bone implements, one-quarter of them ornamented. There were also 20 female figurines made from mammoth tusks, sculptures of birds, etc. The fauna were mainly northern deer; less frequently Arctic fox, rhinoceros, and mammoth; and accidental remains of horse, bison, birds of prey, and other forms. This site belongs to the most ancient monuments of the Upper Paleolithic in eastern Siberia.

269. *Malta* (Upper Horizon).—M. M. Gerasimov discovered this stratum during his excavations in 1932 in the upper part of the loesslike sandy loam 9.45 m. beneath the surface and 0.5 m. above the first cultural horizon (No. 268). Here were found limestone laminae,

fragments of bones of animals, flint flakes, and about 30 large tools of Badai type.

270. *Maltinka*.—Traces of an Upper Paleolithic station were located at the edge of the 40-m. terrace near this village, on the right bank of the Belaia, near the second pond between the Maltinka and Belaia. The finds occurred on a 300-m. stretch of plowed land.

271. *Mondy*.—Typologically Paleolithic stone tools were found by Chastokhin in 1887 on the left bank of the Oka River, a left tributary of the Angara River.

272. *Mozgovaia*.—Traces of this Paleolithic site were found during 1937 by A. P. Okladnikov on the 100-m. terrace on the left bank of the Mozgovaia River, a right tributary of the Angara, along its lower course. This find is of particular significance, because it is the first Paleolithic station reported in this area which lies about 1,800 kilometers from Irkutsk.

273. *Podostrozshnoe*.—This Upper Paleolithic station, discovered by A. P. Okladnikov in 1936, stands on the right bank of Angara on the second terrace above spring flood level. The finds in the loesslike loam consisted of tools made from antlers of the Siberian stag and some stone scrapers.

274. *Ust-Belaia*.—This Paleolithic site lies at the edge of the second terrace at the delta of the Belaia. The cultural deposit lies more than 1.0 m. deep under the Neolithic strata. M. M. Gerasimov in 1936 and 1937 found six large campfires and faunal remains consisting of the deer, elk, beaver, and possibly wolf. The stone inventory is similar to that of Badai (No. 256), mainly large but also some small scrapers, small nuclei and laminae, and two flat bone harpoons.

275. *Ushakovka*.—Stone implements of Paleolithic type were collected by M. P. Ovchinnikov in 1893 on the right bank of the Ushakovka River behind the suburb Rabochaia Sloboda in Irkutsk.

276. *Ushkanka*.—This Paleolithic site on the right bank of the Angara in Ushkanka ravine near Verkholskaia Gora, was discovered in 1926. The inventory is similar to that found on Verkholskaia Gora. The fauna included elk and *Bos primigenius*.

277. *Cheremushnik*.—Traces of an extensive Upper Paleolithic site of Badai type (No. 256) were discovered on the plowed land near Badai on the 60-m. terrace on the left bank of the Belaia. This site lies in the Cheremushnik area 2 kilometers downstream from Badai, near the Usolsk Salt Works. M. M. Gerasimov accumulated here a large quantity of flakes and also of finished tools, mainly large scrapers.

278. *Ponomarevo*.—In 1927 A. P. Okladnikov found typologically

Upper Paleolithic implements on the plowed land along the Biriulka River, a right tributary of the Lena, on the edge of the 80-m. terrace near Zalog.

279. *Ara-Tszokui*.—On the right bank of the Selenga, 12 kilometers northwest of Kalinislinaia in the Troitskosavski *Okrug*, in the sands near Nur settlement, the Buriat-Mongolian Archeological Expedition in 1928 found ostrich eggshells and stone tools of Paleolithic type.

280. *Bozoi*.—Traces of this Paleolithic site lay 18 kilometers upstream from Ust-Orda on the right bank of the Kuda River (Ekgirit-Bulagat *Alimak*) on the slope and at the edge of the lowest terrace. Quartzite and flint scrapers and nuclei lay in the black earth (*chernozem*) deposits and in the loesslike sandy loam.

281. *Dureny*.—The material from the sands on the left bank of the Chikoie River, 25 kilometers east of Troitskosavsk, included stone tools, ostrich eggshells, and bones of fossil animals.

282. *Durungui*.—Stone implements of Paleolithic type from the Upper Yenisei and Angara were assembled by S. I. Rudenko in 1923 in the valley of the Onon River at this settlement. Earlier A. K. Kuznetsov also assembled the same kind of tools in the valleys of the rivers Onon and Ingoda.

283. *Zarubino*.—Material from sands in an isolated ravine near this village lying on the left bank of the Selenga downstream from Ust-Kiakhta was obtained by the Buriat-Mongolian Archeological Expedition in 1928 with the participation of G. P. Sosnovskii. They found stone tools, nuclei, flakes, bones of *Equus hemionus*, large deer, mountain sheep, and hare, and ostrich eggshells.

284. *Ivashka*.—Typologically Paleolithic implements were found in Ivashka ravine opposite Ust-Kiakhta.

285. *Mylnikovo*.—Stone implements of Paleolithic type were collected along the Chikoie River near this village.

286. *Nomokhonovo*.—On the right bank of the Selenga, 25 kilometers upstream from Seleginsk in Shirokaia Pad (Mukhor-khundi), which was filled with dune sand, stone implements and flakes, and ostrich eggshells were assembled on the exposed places.

287. *Nialqi*.—Stone implements of Paleolithic type were found in the sand above the mouth of the Dzhida River.

288. *Ust-Kiakhta*.—In exposed sands on the left bank of the Sava River near this village, stone implements, including nuclei and flakes, and ostrich eggshells (one perforated) have been found. The first report was by Mostits in 1894, then by Laptev in 1924, and finally by Debets in 1928.

289. *Khara-Busun*.—During 1928-1929 stone implements and ostrich eggshells were found on the right bank of the Chikoie River in the sands beside Kudarinskii road about 5 kilometers from Palkanova.

290. *Kharankhoi*.—This site, discovered in 1927 by the Buriat-Mongolian Expedition in sands on the right bank of the Selenga in Kharankhoi ravine, about 11 kilometers upstream from Ust-Kiakhta. Among objects found were stone tools, ostrich eggshells, and bones of *Rhinoceros*, *Bos*, and *Equidae*.

291. *Khabarovsk*.—M. M. Gerasimov found during 1926-1927 stone implements in the loesslike loam at a depth of 0.75-1.0 m. The period was not determined.

292. *Shkotovo*.—A Hungarian prisoner-of-war, I. Parkas, discovered a stone tool similar to the Paleolithic implements found in the Ordos.

ARCTIC PALEOLITHIC²⁷

293. *Anikieva I*.—During 1937 traces of this site were located on the eastern coast of the Rybachii Peninsula, 1 kilometer west of the center of the Tsyp-Navolok settlement at the foot of the southern end of Anikieva Mountain. This site occupied a considerable part of the ancient pebble-covered beach about 37.0 m. above sea level.

294. *Anikieva II*.—At 31.0 m. above sea level on the western slope of Anikieva Mountain traces of prehistoric occupation were scattered over about 20 square kilometers. The finds were made in 1937.

295. *Korabelnaia*.—In 1935 B. F. Zemliakov and P. N. Tretiakov discovered traces of this site at 33.0-36.0 m. above sea level on the surface of the bank of the Korabelnyi brook on the western coast of Bolshaia Motka Bay. The material consisted of quartz flakes and crude implements.

296. *Log-Navolok*.—In 1937 this site was discovered on the northern coast of the Rybachii Peninsula on the crest of the pebbly coastal bank about 20.0 m. above sea level between Cape Log-Navolok and Laush-Guba.

297. *Morozova*.—B. F. Zemliakov and P. N. Tretiakov in 1935 discovered traces of this site on the eastern coast of the Bolshaia Motka Bay between the valley of the Morozova River and the first brook to the south. A large quantity of quartz flakes and implements were found on the shore of a lake 55.0-60.0 m. above sea level.

298. *Ozerko*.—In 1935 quartz scrapers and nuclei-shaped burins

²⁷ Northern part of the Kola Peninsula (Nos. 293-304).

were found on the crest of the coastal bank at 42.0 m. above sea level on the western coast of the Bolshaia Motka Bay at this settlement.

299. *Percevalnaia*.—Traces of this site were found on the eastern coast of the Rybachii Peninsula, 1 kilometer south of the southern outskirt of Tsyp-Navolok settlement on the crest of the coastal bank 36.0-37.0 m. above sea level. A quantity of quartz tools and flakes (also of horn, flint, and quartzite) were assembled in 1937.

300. *Sergeeva*.—Traces of this site were located on the eastern coast of the Rybachii Peninsula between Cape Sergeeva and Tipunova River on the pebbly bank 27.0 m. above sea level. Large, crude implements of quartzite and better-finished implements of flint, horn, and quartz were found.

301. *Tipunova*.—During 1927 large, crude quartzite implements were found on the eastern coast of the Rybachii Peninsula on the southern slope of the elevation which divides the valley of the Anikieva River from the valley of the Tipunova River on the crest of the pebbly bank 40.0 m. above sea level.

302. *Tsyp-Navolok I*.—Traces of this site were found on the western coast of Rybachii Peninsula at the southern outskirts of Tsyp-Navolok settlement on the left bank of the Anikieva River. The site is situated on the edge of the 25-m. terrace.

303. *Tsyp-Navolok II*.—This site, on the southern outskirts of Tsyp-Navolok settlement, is situated on the end of the 25-m. terrace, which surrounds the ancient bay.

304. *Eina-Guba*.—Traces of this site stand on the southern coast of the Rybachii Peninsula in the vicinity of Eina-Guba settlement on the crest of the ancient 20-m. terrace.

IV. MISCELLANEA ARCHEOLOGICA

INTRODUCTION

In this chapter some additional archeological data have been assembled from the Ukraine, Crimea, Black Sea coast, North Caucasus, South Caucasus, Armenia, Don region, Urals, Volga region, Central Asia, and Siberia. These miscellaneous notes supplement previously published material¹ on this same subject. In addition, supplementary data have been placed on microfilm.²

¹I am grateful to Soviet anthropologists and archeologists who sent through VOKS from 1934 to 1945 summaries of their results so that these could be made available in English. For convenience there is appended a list of bibliographical references on Soviet archeology. (H. F.)

American Anthropologist, vol. 38, pp. 260-290, 1936; vol. 39, pp. 457-490, 1937; vol. 40, pp. 653-679, 1938; vol. 42, pp. 211-235, 1940; vol. 44, pp. 388-406, 1942; vol. 48, pp. 375-396, 1946. American Journal of Archaeology, vol. 41, pp. 618-620, 1937; vol. 42, pp. 146-147, 295-298, 1938; vol. 43, pp. 331-332, 507, 1939; vol. 44, pp. 138, 535-536, 1940; vol. 45, pp. 113-115, 299-301, 441-444, 626-628, 1941; vol. 46, pp. 144-147, 277-281, 423-427, 568-569, 1942; vol. 47, pp. 355, 486-488, 1943; vol. 48, pp. 201-210, 295, 395, 1944; vol. 49, pp. 102-104, 177-179, 377, 423-427, 1945; vol. 50, pp. 191-192, 307-311, 1946; vol. 51, pp. 201-202, 322-323, 1947. American Journal of Physical Anthropology, vol. 4, No. 4, pp. 501-502, 1946. American Journal of Semitic Languages and Literatures, vol. 52, pp. 138-141, 1936; vol. 53, pp. 123-124, 1937; vol. 55, pp. 109-112, 333-336, 1938; vol. 56, pp. 322-324, 438-440, 1939; vol. 57, pp. 112, 194-196, 327-329, 1940; vol. 58, pp. 109-110, 1941. American Review of the Soviet Union, 1945, pp. 37-39; 1946, pp. 67-75. Antiquity, 1938, pp. 341-345; 1939, pp. 99-101; 1940, pp. 404-426; 1941, pp. 194-196; 1947, pp. 42-45. Ars Islamica, vol. 5, pt. 2, pp. 233-271, 1938; vol. 6, pt. 1, pp. 158-166, 1940; vol. 9, pp. 143-150, 1942; vol. 13, pp. 139-148, 1947. Asia, 1940, pp. 272-277, 327-330; 1941, pp. 243-244, 723-727; 1943, pp. 529-531; 1946, pp. 120-121. Gazette des Beaux-Arts, vol. 23, pp. 129-134, 1943; vol. 29, pp. 65-74, 1946; vol. 31, pp. 123-126, 1947. Southwestern Journal of Anthropology, vol. 2, No. 2, p. 239, No. 3, pp. 340-360, 1946; vol. 3, No. 3, pp. 212-229, 1947.

²The following articles have been recorded on Microfilm No. 1605 in the American Documentation Institute, c/o Library, U. S. Department of Agriculture, Washington 25, D. C.: Eneolithic Station at Ochmchiri, Abkhazia, pp. 4-29; Olvia (Olbia) Expedition, pp. 30-42; European Russia: Archaeological Reconstruction in European Russia, pp. 60-66; Archaeological Investigations in the Uzbek S.S.R., by B. Grekov and A. Iakubovskii, pp. 89-93; bibliography, pp. 94-99. There have also been placed on Microfilm No. 2308 Notes on Soviet Museums and Research Institutions, pp. 1-126, and pls. 1-130: Baku, pp. 3-6; Yerevan, pp. 6-7; Tbilisi, pp. 7-8; Ordzhonikidze, pp. 8-9; Moscow, pp. 9-18; Archaeological Reconstruction in European Russia, 1941, pp. 19-25; Excavations

UKRAINE

According to Boriskovskii³ the earliest site in the Ukraine is the Lower Mousterian station at Kodak, on the right bank of the Dnieper, discovered in 1927 during construction of the dam at Dnepropetrovsk. Flint flakes were found in association with mammoth, Siberian rhinoceros, great-horned deer, reindeer, bison, bear, and lion.

Boriskovskii has given a popular but carefully written presentation,⁴ attractively illustrated,⁵ of the Paleolithic cultures from the first large-scale excavations by Khvoiko in 1893 to the latest finds up to 1940 at the famous sites of Mezin, Gontsi, and Pushkari.

Boriskovskii concludes with a description of the Neolithic finds at Marinopol, where in 1930 were found 124 burials with rich polished-stone and bone inventories.

CRIMEA

Chersonesus.—Excavations in Chersonesus,⁶ begun in 1827 and interrupted in 1914, were renewed in 1926. During this era they were

in Central Asia, pp. 26-35; Soviet Types, pp. 36-39; and List of Scientific Institutions and Branches of the Academy of Sciences of the U.S.S.R., pp. 40-129. The plates include: 1-48, exhibits in IAE; 49-95, Lake Onega rock engravings; 96-101, Minusinsk bronzes; 102-106, gold treasure from Abakan near Minusinsk; 107-111, Central Asia; 112-116, reconstructions by M. Gerasimov; 117-118, leather coat restored in State Historical Museum, Moscow; 119, Zaraut-Sai rock-shelter paintings; 120-130, exhibits in Museum of Oriental Civilizations, Moscow; 131-134, anthropometric form used in Museum of Anthropology and Ethnography; 135, map of Moscow locating museums. Supplementary material has been placed on the following Microfilms in the American Documentation Institute: Nos. 2214, 2307, 2310, 2344, 2414, 2415.

See also Lauriston Ward's Reference List of the Archeology of the Soviet Union, Harvard University, January 1947. (Mimeographed.)

³ Boriskovskii, P. I., *Liudina kamianogo viku na Ukraini* [Stone Age man in the Ukraine]. Institute of Archaeology, Academy of Sciences of the Ukrainian S.S.R., p. 128, Kiev, 1940. [In Ukrainian.]

⁴ The book is divided into eight chapters: 1, Glacial period; 2, Earliest human traces; 3, Transition to the Upper Paleolithic; 4, Mezin; 5, Lower Paleolithic man near Kiev; 6, Gontsi; 7, End of Lower Paleolithic; 8, Neolithic.

⁵ This account has some of the charm of Breasted's "Ancient Times." The interest is particularly enhanced by numerous line drawings, some of them really inspired, of Paleolithic fauna and implements. Illustrations include reconstructions, on the basis of recent finds of such Quaternary fauna as the Siberian rhinoceros, cave bear, and cave lion. Of special interest are the original reconstructions of tools and dwellings. (E. P.)

⁶ Translated by Mrs. David Huxley from the French summary in *Materialy i Issledovaniia po Arkheologii SSSR*, No. 4, pp. 275-278, Moscow and Leningrad, 1941. Minor editorial revisions have been made to conform to our style. (H. F.)

undertaken in a haphazard manner, at several places and without a coordinated plan. During 1931 the question of excavation sites was examined, and it was decided that priority should be given to places which were in the process of destruction from natural causes. It was known that the most threatened area was the northern shore of the Chersonesus, where at the lowest points the archeological stratum was directly encroached upon by the sea. It was here that excavations were started in 1931, with the object of studying the coastal section of the city. An area of approximately 700 square meters was uncovered.

The oldest remains were supporting walls, a pear-shaped cistern, and some wells. In the lowest stratum, close to virgin rock, were found amphora handles, which bore manufacturing marks of Chersonesus, Rhodes, and Cnidus, as well as fragments of black-glazed pottery, both local and imported.

This first period of construction covered from the end of the fourth to the second century B. C.

Dating from the second period were some massive masonry walls and cisterns, paved with bricks (12-20 cm. thick) bound together with cement or simply with mortar. The walls of the cisterns were coated in red parget of the same composition—a mixture of chalk, sand, and finely crushed pottery, which is very durable. Two cisterns are remarkable for their small size; they were placed together and were probably used for the storing of finer grades of fish; the larger tanks were used for salting anchovies (*kamsa*). The large number of tanks illustrated the extensive development of the fishing industry and the exporting of fish during Roman times.

During the first centuries of our era, one cistern and some of the wells were covered by a layer of earth. In this layer, red-glazed pottery of fine workmanship, dating from the first-second centuries B. C., was found. At other places in this third stratum, silver and bronze coins of the first-fourth centuries A. D. were uncovered, as was a bronze statue of Asclepius, holding in his right hand a rod entwined by a serpent. These cisterns can be ascribed to the first-fourth centuries A. D.

At the base of the second level, well-built walls rested on rock. This layer, filled with refuse, was characterized by a white-glazed clay pottery, decorated with a stamped or painted design, which can be dated from the ninth-tenth centuries; it appears to be of local manufacture. In one section a large quantity of ninth-tenth century coins were found on the ground and also a gold plaque decorated with enamel cloisonné of fine workmanship, showing two peacocks with

a vase between them; this plaque was attributed to the ninth-tenth centuries. The constructions of this era disintegrated at the end of the tenth century and were engulfed by a layer of rubble 2 m. deep.

During the following period, a series of buildings were constructed on this foundation, and belonged to several groups of dwelling houses. The walls were poorly built of stones held together with mud; the plan was irregular, the dimensions too small, the furnishings meager, the floors of earth, and the walls unplastered. During this later period (twelfth-fifteenth centuries) this district was rebuilt according to a new plan. Generally, there were inner courtyards; in one courtyard was a well which served four houses. The Roman cisterns, partly covered by the second layer, were then sometimes used as cellars.

Within the houses were unearthened working equipment such as fishing tackle and net weights, boats, dragnets for shell fishing, stone-working and weaving tools, red-glazed pottery decorated with an engraved design, etc. In one well a glazed bowl was found with an interior design showing Theodore Stratilat astride a horse killing a dragon.

The buildings of the late period were destroyed by fire, apparently at the time of the destruction of Chersonesus at the end of the fifteenth century. The floors were covered by thick debris, including fragments of coal, soot, charred wood, and burnt walls and objects.

During 1932 excavations were made to the east of the area explored in 1931; 700 square meters were uncovered.

Architectural remains of the Greek epoch are rare, having been destroyed at the time of the construction of the basilica. In the clay near the rock, amphora handles were found which bore the mark of the Chersonesus astinomes, as were fragments of black-glazed pottery dating from the third-second century B. C.

Near the western street was a large cistern with a flooring of brick and mortar and walls coated in red parget. The bottom of the tank was covered with a layer of salted anchovy, 0.25-1.0 m. thick. The fish formed a compact brown mass. The type of fish was identifiable through the spines. After the cistern was no longer used for salting fish, it had been used as a cesspool. Directly above the fish lay pottery of the later Roman period and coins from the time of Zenon and Justinian the First. During the sixth century, when the basilica was built, it was used as a limekiln; its fourth use was for the storage of provisions; the fifth, during the ninth-tenth centuries, was a final conversion into a cesspool. The finding of this cistern with its fish remains was of great importance, not only for the determination of construction date, but as an indication of the original purpose of the large number of similar tanks found throughout the city. It is certain

that they date from the first-fourth centuries. A marble gravestone, with an epitaph in verse, belongs to the third century.

The basilica, found in the eastern part of the district, dates from the sixth century. The dimensions were 26.0 m. long and 16.5 m. wide. It had three naves, with a narthex and pentagonal apse. In the northern colonnade, three marble bases, and next to them a fanlight, are still in place. The marble rood screen in the apse is partially in existence. The side naves had a mosaic floor, whose geometric design was carried out in white, red, yellow, and black in the north nave, and three colors (no black) in the south nave.

Architectural details included marble capitals, fanlights, coignes with carved or polychrome ornamentation. The basilica was destroyed by approximately the end of the tenth century and was subsequently covered by a heavy layer of construction rubble.

Some time later a chapel was built on the ruins of the basilica, the whole being within the apse of the original basilica. Within the chapel, 35 mausoleum tombs were erected, and in the western part, a guard hut with a stove in the eastern corner.

The tombs were in some degree arranged according to a pattern. They contained 10, 15, 25, even 35 and 60 skulls, but very few long bones were found. This shows that when the remains of the dead were transferred from the cemetery to the mausoleum near the temple, it was considered sufficient to take only the skull. In tomb No. 6 the shroud was decorated with bone plates: in the corners are large lamellae with pictures of griffons, a lion, and a hind; lateral bands with circles and squares intersect in the center of the design, also circles made of small squares, lozenges, and triangles, framed with straight and curved lamellae.

Such a design was found for the first time in Chersonesus and constitutes a remarkable example of the local medieval art of bone sculpture. The shroud appears to have belonged to a very wealthy person. Beads were found in tomb No. 20 together with one string of paste beads encrusted with colors and another of lignite and a silver pendant.

Other tombs yielded hollow bronze buttons, decorated bone roundels, and ninth-tenth century coins. The tombs dated from the tenth, eleventh, and later centuries.

In the waterfront section of the district, compounds were uncovered in the first layer which obviously belonged to two houses. Two rooms had been used as food-storage cellars with wooden floors. In one cellar were more than 50 assorted clay vases. Such an abundance of pottery permits the conclusion that at this later date also the art of

pottery making in the Chersonesus had reached an extensive degree of development. Tiles with varied brands also confirm this. In the same cellar, two small icons were discovered: one in slate with the image of St. George bearing a lance and shield; the other in bronze with the image of Jesus Christ. Both are covered with gilt, are distinguished by their fine workmanship, and can be ascribed to the ninth-tenth century. Room VII contained wells with a water level of 3.60 m. In other rooms were mills, mortars for crushing grain, fishing tackle, and a quantity of pottery articles. One room had bronze chains with an imperial orb, belonging to an ecclesiastical lamp.

On the floors of rooms of this period, there were also traces of a fire, as in the district excavated in 1931. It is certain that both districts were burned at the same time that the entire city was destroyed by fire at the end of the fifteenth century.

During 1933 excavations were continued along the north shore of the Chersonesus to the east of those undertaken in 1932. Only the top stratum was removed over an area of about 500 square meters; it consisted of an accumulation of debris formed from the destruction of buildings. Their floors were covered with soot, fragments of coal, burnt articles, and pieces of tile.

The walls were of rough stone (*ashlar*) bound together with mud, with wooden beams inserted to connect the walls. The plan of the buildings was usually irregular, the dimensions small, the floors earthen, the walls unplastered or sometimes with a clay coating.

The rooms belonged to two houses. In the first there was an oven, in another two ovens—a small one in the east corner and a large one in the north. These ovens were built of bricks and pieces of tile, bound with clay; they were fitted with an arched "front oven": the hearth was decorated with squares of baked earth. The roof had an opening for the chimney; tiles pierced with a round orifice and chimney pipes were found. The presence of two ovens in one single room and a third in another room of the same house indicates that this was a large bakery, making bread for sale. This type of stove is rare in houses of the period; normally rooms were heated by simple stone hearths.

The second house was located in the eastern part of the district. In room VIII there was a mortar for grain crushing next to a post with a cavity for a pestle. Similar mortars were found in many rooms of the same period during the 1931-1932 excavations. Room IX was used for food storage: on the floor by the walls were a large number of amphorae containing the remains of fish. Here also were production tools: 2 iron swing-plows, more than 100 bronze fishhooks, 40 net

weights, and a quantity of metal articles including padlocks, screw rings, bronze bowls, and others. Room X had a hearth, and on the floor near the west wall were part of a marble column and a cubed stone; this was possibly either a smithy or a workshop. Room XII was a courtyard; in the east corner was the cesspool sump.

The numerous and varied furnishings (work tools and usual articles) allow certain conclusions to be drawn as to the occupations and social organizations of the inhabitants of this dwelling. They engaged in farming, livestock raising, and fishing. Others were artisans such as smiths, locksmiths, builders, and weavers.

It was a regime of small undertakings, sufficient in themselves; trade had evidently ceased at this period since no imported articles were found.

The houses date from the last centuries of the city's existence, or approximately from the fourteenth-fifteenth centuries.

These observations on the latter part of the medieval period, made during 3 years of excavation, can be extended to some degree over the entire city:

1. The economic level of the population during the latter stages of the city's existence was very low.

2. By their occupations and their means of existence, the populations lived mainly in a rural condition through the natural economy of small, independent, and self-sufficient undertakings.

3. In general, the Chersonesus lost its former importance as a large trading center and became a small town with but slender economic connections with its immediate vicinity.

Tiritaka.—Although ancient writers referred to Tiritaka as a city, the excavations by the Bosphorean Expedition of IIMK in collaboration with the Kerch Archeological Museum under the direction of V. F. Gaidukevich⁷ disclosed that in general planning and many other essential traits this settlement did not resemble the usual ancient cities.

Tiritaka was a well-developed industrial settlement. An additional group of fish-salting cisterns uncovered during 1939 in the southern part of town evidently belonged to a very extensive establishment. There is no doubt that during the Roman period Tiritaka was one of the most important centers for the export of fish. The 1939 excavations in the western part of the site were a continuation of those of 1938 in the course of which a building of the sixth century B. C.

⁷ V. F. Gaidukevich, in *Kratkie Soobshcheniia*, No. 4, pp. 54-58, summarized the 1932-1939 excavations.

containing archaic terra cottas and many other interesting finds had been discovered.

This building was completely excavated, and many service structures surrounding the building were uncovered. These included a barn or storeroom, a paved courtyard, a basement with a flight of steps leading into it, and extensive grain-storage pits lined with stone.

A late Roman dwelling complex discovered in 1939 was buried under a stratum of debris 3.5 m. thick. The walls were preserved to the height of 2.0 m. The main building, paved with stone flags, communicated with a small courtyard also paved with flags. In the floor of the main building opposite the entrance a large sunken pythos with a capacity of several hundred liters was uncovered. This was probably used for grain storage, since many charred grains of wheat were found inside the building close to the pythos, as well as several hand mills. A pit 1.0 m. in diameter and 68 cm. deep filled with ashes, near the pythos, contained a pottery lamp, a bone needle for weaving fish nets, an iron hammer, whetstones, and a gray-ware pitcher of Sarmatian type decorated with a band of intersecting lines formed by polishing.

The finds from the floor of the building included many pieces and fragments of molded pottery, several lamps, a round bronze mirror, clay spindle whorls, fragments of glass vessels, and red lacquer platters of late Roman type, one of which was stamped with the sign of a cross, and several bronze coins. Large pointed amphorae of late Roman type were also unearthed; many had been repaired by means of lead brackets. The building itself had been destroyed by fire: its floor was covered by coal and ashes from the burned wooden parts of the structure. Many of these amphorae had apparently been stored on the second floor of the building but had fallen down in the course of the fire. An outside stone stairway parallel with one of the walls of the building led to the upper story.

The prevalence of burned buildings in Tiritaka, of which several had been previously discovered, suggests that this city was attacked and partially destroyed. The finds from the late Roman building included also the remains of a charred cable, probably a part of some sort of fishing gear, and of two dozen net weights manufactured of stones of varying sizes, each encircled by a shallow notch for attaching to the rope. A small fish-salting cistern, 1.75 x 1.37, and 1.90 m. deep, was found in an adjoining outbuilding.

In the lower part of one of the walls of the main structure was found a clay-covered niche containing the bones of a young pig and a lamb, covered by sea sand containing long scales of *scorpiuga*, and

sherds of amphorae. The niche also contained a clay lamp. Apparently this niche was connected with some sort of ritual.

A small stone *terapan* (bench for pressing grapes) was found on a dais in the courtyard. Many finds connected with viticulture from previous excavations seem to indicate its important role in the economic life of the Bosphorus during the late Hellenistic and Roman periods when the importation of wines from abroad became curtailed. A second large winery of the second century B. C., discovered in 1939, had been partially buried by a railroad embankment. Nonetheless, the large pressing platform was uncovered, together with a gutter leading to a cistern. Both the platform and the cistern were faced with a white cement differing in composition from the Roman cement of that period. On the basis of this and the earlier discoveries, it is now possible to reconstruct the evolution of viticultural technique in Tiritaka from the second century B. C. to the third century A. D.

The 1939 excavations indicated that Tiritaka was sacked during the fourth century A. D. This destruction occurred as a result of one of the mass tribal migrations in the northern Black Sea area, which led to the final dissolution of the Bosphorean State. But Tiritaka did not disappear altogether at that time, as the finds from the excavations include many objects of the Early Medieval period. Thus, in the western part of the site a quantity of pottery of that period had been found, including a pythos stamped with the name of the potter and the incised sign of a cross of the type attributed to the fifth or sixth century A. D. The fisheries continued during this period, although most of the Roman cisterns had become disused. The main occupation of the local population seems to have been agriculture. Tiritaka was abandoned during the seventh or eighth century.

Many sherds of archaic pottery were found, including a fragment of a painted pot. Particularly abundant were the finds from a late Roman house, and also a quantity of objects from the Bosphorean house of the third or fourth century A. D.

A stoppered amphora, attributed to the fourth or fifth century A. D., found near one of the fish-salting complexes, contained nearly 3.5 kilograms of crude oil. The amphora was of the elongated cylindrical type with a conical bottom. The neck had been closed by a bunch of straw which, when permeated with the solidified crude oil, formed a completely hermetical seal. The liquid was analyzed by R. R. IAnovskii of the Leningrad Chemico-Technical Institute. The liquid which was characterized by IAnovskii as "crude oil or a product of crude oil" contained several wisps of straw. According to the classical authors crude oil was used for lighting and also as medicine.

Neapolis.—During the latter part of 1945 an expedition under the leadership of P. Shults was sponsored by the Museum of Fine Arts in Moscow and the Institute for the History of Material Culture (IIMK) of the Academy of Sciences of the U.S.S.R.

Shults began excavations at Neapolis, the Scythian capital, often mentioned by early writers. The numerous finds indicate that Neapolis existed from the fourth century B. C. to the fourth century A. D. This ancient city was encircled by a thick, protective wall of unique masonry. The excavations revealed the first specimen of monumental Scythian architecture consisting of a large house whose basement had been hewn out of rock.

The first Scythian winery to be found contained marble goblets as well as Scythian and Greek pottery of different periods, some of them bearing Greek inscriptions.

The first Scythian mural painting, showing no evidence of Greek influence, came to light. The designs resemble those with which the modern Ukrainians decorate their cottages and household utensils. The clay roof ornaments and animals found during the excavation of another site also resemble Russian roof ornaments and Slavic toys.

Scythian handicrafts, in particular pottery, were as fine as other expressions of art. A complex kiln for pottery making was unearthed.

Archeological surveys were conducted in many parts of the Crimea with a view to establishing the boundaries on this peninsula of the Scythian State, which evidently extended along the Black Sea coast as far as the Danube.

A system of fortifications, consisting of three lines of defense, protected the Scythians from outside enemies:

1. In the north stood the rampart and moat at Perekop.
2. Along the Salgir River.
3. Along the Alma River at the boundary between the foothills and the mountains.

Along these lines stretched a chain of fortress towns. On the western coast there were also Scythian fortifications at intervals of 6 to 8 kilometers. Evidently they protected the Scythians from invasions by sea and at the same time served as ports.⁸

BLACK SEA COAST

Cave excavations.⁹—During 1936-1937 S. N. Zamiatnin excavated two caves in the Sochi and Adler *Raions* of Krasnodar Krai. The

⁸ Quoted from Nina Militsyna in the Moscow News, February 2, 1946.

⁹ Translated and summarized from S. N. Zamiatnin, *Navalishin-kaia i Akhshtyrskaja Peshchery na Chernomorskom Poberezhje Kavkaza*, Bulletin de la Commission pour l'Étude du Quaternaire, Nos. 6-7, pp. 100-101, Moscow, 1940. See also Field and Prostov in Amer. Anthropol. vol. 44, No. 2, p. 213, 1942.

work was concentrated in two areas: in the Kudepsta River gorge near Navalishino and in the valley of the Mzymta River and the Akhshtyr Gorge.

Navalishino Cave is situated on the right bank of the Kudepsta River, within 12 kilometers of the seacoast, at a considerable height above the river.

The excavations embraced an area of 22 square meters at the entrance to the cave. In addition, a small excavation was made deep inside the main corridor of the cave.

The upper horizons yielded microlithic implements and the bones of hamster, badger, and *slipysh*[?]. The occasional remains of the cave bear (*Ursus spelaeus*) found here belong to other strata, and are obviously located in a secondary deposit.

Below that lies a stratum containing Upper Paleolithic finds, while the faunal remains are mainly those of cave bear. Here were found also the bones of elk, goat, hamster, fragments of tubular bones of birds, and also shells of *Anodonta* and *Helix*.

The lowest stratum yielded a few typical Mousterian implements. Among the animals represented were cave bear, wolf, and goat.

The character of the finds indicates that Navalishino Cave was not occupied by a permanent settlement, but was rather a seasonal, temporary site.

Akhshtyr Cave (pls. 1-4) is situated on the right bank of the Mzymta River, opposite Akhshtyr, within 15 kilometers of Adler.

The excavators uncovered an area of 60 square meters. The finds from the upper stratum included very late pottery and bones of domestic animals.

Below this were found Upper Neolithic pottery and polished implements. In this stratum also belongs a flexed inhumation of a child. Among faunal remains were wolf, roe, moufflon, and wild pig.

Still lower lies a sterile stratum, below which were found objects of the later stage of the Upper Paleolithic. The fauna included cave bear, fox, wildcat, marten, deer, elk, roe, moufflon, goat, and wild pig.

Beneath the Upper Paleolithic level lay the Upper Mousterian stratum, which yielded a large collection of implements and fauna, the latter, with the exception of the elk, which was absent, being identical with that of the Upper Paleolithic.

The Lower Mousterian was also rich in implements, which permitted comparison with those from Iiskaia, and the finds from the upper horizons of Kiik-Koba in the Crimea.

Since the faunal remains were in a very poor state of preservation,

only the following could be identified: large deer [?], cave bear, and wild pig.

The underlying strata are devoid of archeological finds and consist largely of gravel deposited by the floods of the Mzymta River, which since that time has managed to deepen its valley by 120 m., as demonstrated by the marks at the bottom of the cave.

Conference on material culture.—The material culture of the Black Sea coast area in ancient times was the subject of a recent conference¹⁰ in Leningrad attended by specialists from archeology, history, and art research institutes as well as universities in Moscow, Kiev, Odessa, Kharkov, Voronezh, Krasnodar, Saratov, and Leningrad.

The conference heard and discussed more than 30 reports treating various aspects of the life, socio-economic structure, religion, art, and ethnography of the Black Sea coast area at various periods and in many localities. Most of them were summaries of researches by Soviet scientists, in particular field investigations carried out just before the war and during the 1945 season.

Professor Kovalev pointed out that the Black Sea coast area was a flourishing center of culture in antiquity, and exerted its influence on Slavonic tribes.

V. Gaidukevich observed that recent researches have shown that the Greek cities on the Black Sea coast area in ancient times were not isolated seats of culture and that the local population played an active part in building up the ancient culture. Soviet archeologists designate as Greco-Scytho-Sarmatian culture. Although the local tribes were subjected to the influence of Greece, in general they retained their own original culture.

This thesis was corroborated by results of numerous excavations reported at the conference, for example, those brought back by the expedition led by P. Shults last summer to the site of the ancient Scythian capital, Neapolis.

A prominent place on the agenda was given to reports on studies of the relations between the local population of the Black Sea coast steppe areas and the Greek colonies. To understand these relations properly it is necessary to know something about the period preceding Greek colonization. This was dealt with in a report by A. Jessen, who mustered facts indicating intensive development of trade and cultural ties as far back as the third millennium B. C. among the tribes living along the Black Sea coast. Archeological data show that articles from the Near East penetrated through the Caucasus into the Kuban

¹⁰ Summarized from the Moscow News, June 8, 1946.

area from the western part of Asia Minor, the Aegean basin, and the Balkan Peninsula to the right bank of the Dnieper [present-day Ukraine] as far back as the end of the third and the beginning of the second millennium B. C. Speakers cited many interesting new data on the links between Black Sea coast and Greek cities—Attica, Corinth, and Aeolia—as well as Ionian trade centers.

NORTH CAUCASUS

Adighe A.S.S.R.—A tombstone believed to date back to the first century of our era was recently acquired by the regional museum in Krasnodar. This monument was unearthed in a quarry not far from the place where 2,500 years ago the Greeks founded the town of Sadi (Cepi) which is thought to have been a summer resort for the wealthy slave owners from Phanagoria, the second capital of the Bosphoran Kingdom. It is made of limestone and is in the form of a miniature chapel supported by columns with a niche in which stands a warrior wearing a conical helmet, a short coat, and a sword.

SOUTH CAUCASUS

Kuftin's¹¹ report is divided into two parts: a description and analysis of the materials excavated near Igdir on the right bank of the Araxes River during 1913 by B. F. Petrov and now in the State Museum of Georgia in Tbilisi [formerly Tiflis]; and the establishment in the South Caucasus during the Eneolithic period of a proper focus of cultural development contemporaneous with the oldest objects found by Petrov.

The upper stratum of the Igdir monument yielded an unusual cemetery columbarium with the ashes of the dead in red polished earthenware pitchers with a round hole pierced in the side. In only one case was there an inhumation. These vessels were placed, together with the personal inventory, in the clefts of a tufa cone. This lava flow covered the ash layers of an ancient settlement, situated to the south of the cemetery beyond the road from Igdir to Markara.

Since evidence of the custom of cremation had not yet been seen in the South Caucasus during the pre-Roman epoch, and because of

¹¹ Kuftin, B. A., *Urarsku "Kolumbaru" u podotsvli Ararata i Kuro-Arakssku Eneolit.* Acad. Sci. U.S.S.R., Tbilisi, 1943. This study was received from Dr. Kuftin in Leningrad on July 2, 1945, while I was a guest at the Jubilee Sessions in Moscow and Leningrad celebrating the 220th anniversary of the Academy of Sciences of the U.S.S.R. The summary in English has been edited and condensed. See footnote 14. (H. F.)

the presence of the red ware and iron weapons, and, finally, because of the finding in the neighborhood of the cemetery of a silver denarius of Antonius the Pious, the graveyard had been attributed to the Roman epoch.

An analysis of the inventory by Kuftin and his assistants shows the fallibility of thus fixing the date. Fragments of a bronze vessel, found in one of the graves, belonged to the well-known type of bucket from the Colchian-Koban Bronze Age and also found in the Ukraine in pre-Scythian barrows.

Kuftin succeeded in connecting the red polished pottery with a similar type from Toprak-Kala on Lake Van and also from Armavir-Blur,¹² where during 1879 A. S. Uvarov found similar pottery as well as some bichrome ware¹³ taken erroneously for late Roman.

Among the beads from the columbarium, which do not reveal any Hellenic or Roman influence, there are three stamp seals with zoomorphic figures: one toggle-shaped bead seal from the grave with the inhumation; and two columnar pendants, in which Kuftin establishes, because of the similarity of the pictures to the earthenware stamps from Toprak-Kala and a series of other correspondences, a type of Urartian seal, little found up to the present, in which is preserved in contrast with the stamp cylinder prevalent in other parts of the Near East, the archaic figure of the stamp seals of Asiatic stock.

Thus, Kuftin came to the conclusion that the cemetery excavated by Petrov does not date from the Roman but from the Van epoch, belonging, as it does, not to the native population, of which the types of tomb and tomb inventory of that time are well known, but evidently to one which had come from Lake Van. Consequently, it must be presumed that there long existed in eastern Anatolia the custom of cremation, a practice not foreign to the early cultures of Mesopotamia and Syria and practiced later in the Kingdom of Mitani and in the burial of the Hittite kings.

The proposed attribution of the columbarium to the Urartians explains the different composition of the necklaces, foreign to the South Caucasus for this date. For example, instead of carnelian, which was the usual material for this period, ribbon agate and colorless glass predominated. In addition, the style of the bronze bracelets with lions' heads was similar to that found at Zakim associated with a bronze belt, the ornamentation of which, in its time, was compared with that of a sword in the Melgunov treasure.

¹² This is the town of Argishtichinli of the Urartian inscriptions.

¹³ This pottery is probably correlated with the types from Mukhanat-Tepe in Yerevan [formerly Erivan].

By drawing a parallel between this belt and the bronze plate from Shirak in Yerevan Museum and another belt, found in 1905, at Gushi on Lake Urmia [Rezaiyeh] together with the bronze bulls' heads published by F. Sarre and A. U. Pope as Achemenid and Iranian, we try to prove the Urartian origin and age of all these monuments. In this category are also the remarkable bulls' heads, similar to those from Toprak-Kala, on chariot poles in the British Museum, and especially to the Hermitage application to a large bucket or cauldron, found with a handle in the form of a siren of Urartian type.

On the basis of the definite dating which Kuftin obtained for the cemetery with cremation, the previously mentioned discovery in one of the graves of a fragment of a bronze bucket acquires a new significance. This gives a more precise date for the flourishing stage of Koban bronze, which had perhaps been carried back too far, and in which was developed the most skillful molding of bronze weapons (in particular of typical axheads and flat celts with lateral projections), while the territory of Lake Van, poorer in copper ore, had already passed on completely to weapons of iron.

The inventory of the village, which lies beneath the lava flow to the south of the columbarium, is of an entirely different character and is therefore not connected chronologically. The cultural strata consist of huge layers of ashes, used by the peasants for fertilizing the fields, and of large heaps of ruined mud brick. These layers yielded many bones of horned cattle, stone fragments, grain pounders, obsidian flakes, and sherds. There were no traces of metal or of glass, with the exception of a group of beaten-copper ingots perhaps originating here.

The pottery, quite distinct from that of the columbarium, had nothing in common with that from South Caucasian graves of the Bronze Age. It is distinguished by the combination of archaic methods of modeling, without using the potter's wheel, with artistic molding and a fine finish given to the vessels through the use of a slip and elaborate polishing.

The characteristic features include: hemispherical handles, a broad cylindrical neck, a lid, the black shiny outer surface of the sherds with a pink inner surface, and the ornamentation of the neck with a ribbon-like, geometrically cut belt.

Associated with the fragments of a vessel there were pottery fragments, horseshoe-shaped, with a handle behind; these bear some analogy to the "horned altars" from Alishar III and through them with the puzzling Aegean attributes of a goddess on a double ax.

In the absence of any systematic excavation, and because of the haphazard nature of the collected material (in particular the fragment

of a bichrome vessel not clearly documented), it is only possible to assign to its approximate chronological place this new type of Igdir ash mound by drawing on a wider range of parallel examples on which more light has been thrown stratigraphically.

The second part of the work, which is devoted to this phase, falls into three parts:

1. The establishing of the presence of parallel monuments among the old collections in the State Museum of Georgia.

2. A survey of corresponding materials obtained from Kuftin's excavations.

3. An attempt to establish the existence, prior to the third millennium B. C., of a singular, highly developed Eneolithic phase in the central part of the Kura-Araxes basin, as a local basis for the development of the flourishing cultural focus of the Bronze Age, revealed by the excavations in Trialeti.¹⁴

The accurately documented excavation of an ash grave carried out by E. G. Pchelina during 1923 in Kiketi near Tbilisi, assigned by Kuftin to this level, together with the pottery from the Igdir ash mound, proved to be a key to the understanding of the Eneolithic objects in the old collections in the Georgian State Museum. This ash grave, with a burnt earthenware coating, yielded several groups of earthenware vessels which now appear as one contemporaneous culture complex. The following vessels were unearthed: (a) a large, finely polished black vessel with a pink inner surface, ornamented with large double spiral figures (like eyeglasses) in relief; (b) and (c) pinkish-brown urns with a slip and miniature handles at the base of the neck, one with single birdlike (ostrich ?) figures in flat relief on the neck, the other with a cut angular design on the shoulders; (d) a tureen, thick-walled, roughly modeled with layers of carbon in the clay but a glossy-black surface; and (e) a gray vessel painted red.

Thus, by a comparative analysis of the pottery Kuftin succeeded in establishing that in the Armavir mound A. S. Uvarov touched not only the Urartian stratum, unnoticed by him, but also the most ancient Eneolithic level, both in the settlements and in the graves, also not understood by him. In addition to the characteristic vessels, the finding of fragments of a horseshoe-shaped stand of the above-mentioned Igdir type is significant. This seems to be a leading type for the

¹⁴ Kuftin, B. A. Prehistoric culture sequence in Transcaucasia, *Southwestern Journ. Anthropol.*, vol. 2, No. 3, pp. 340-360, 1946, and pp. 1-26 on Microfilm No. 2310 in American Documentation Institute. The summary in English has been edited and condensed by Henry Field.

stratum in the South Caucasus with which we are concerned and has been found near Karakurt in Kars Province of Nakhichevan and in Shengavit near Yerevan.

In making a stratigraphic study of the horizon with which we are concerned, some help is afforded by the short account by E. Lalaian of the excavations during 1904 in Nakhichevan, of the ash mound of Kul-Tepe with cultural level many meters in depth in which strata containing painted pottery overlie a deposit with black ware.

To this latter, supposedly, must be assigned three remarkable vessels polished black, with hemispherical handles, narrow concave bases and specific ornamentation, bearing witness to the absolutely original artistic style inherent in this culture. A main characteristic is the dynamism of the linear movement inside the externally balanced, closed, curvilinear figures, executed concavely and convexly, and with spiral tailpieces, adorning only the front of the body of the vessel, while around the neck runs a cut-out belt of rhythmically recurring rectilinear geometric elements.

Lalaian did not pay due attention to these vessels nor did he distinguish a grave with a finely molded scoop and a goblet, of the shape in question, from the usual Late Bronze and Early Iron Age tombs discovered by him during 1905-1906 on the west bank of Lake Sevan.

The first substantial material for judging the cultural layer characterized by this ceramic complex is given by Lalaian's excavations during 1927 on Eilar mound, where he found a cyclopean fortress with an inscription of Argishti concerning the conquest of Darani. In addition, Lalaian excavated during 1913 Shresh-Blur tumulus at Echmiadzin.

Lalaian assigned the lower cultural strata of these two mounds to the Neolithic period on the basis of a mistaken interpretation of the stone querns, flaked pebbles, flint and obsidian flakes, and bone bodkins. This was in direct contrast to the rooted prejudice of reckoning cultural life in the South Caucasus as beginning only from the Late Bronze Age, immediately before the Urartian expansion.

The pottery from the lower stratum of Eilar is relatively poorly decorated, i.e., with bosses and hollows forming a kind of facial pattern on one side of the body of the vessel, like that on the pitcher found during 1869 in Zaglik. The molding and the shape of the vessels are especially similar to the Igdir pottery, while at Shresh-Blur and Kul-Tepe the designs are distinguished by one-sided but complicated geometric compositions, symmetrically balanced, with the spiral tailpieces replaced by isolated concentric circles. This is particularly clear when comparing them with the ornamentation, carried out in

relief, of the black polished urn, also Eneolithic, from Frangnots near Echmiadzin.

The presence in this stratum with similar pottery of "round dwellings with one entrance" of the "tholos" type discovered by Lalaian at Eilar was confirmed later by excavations at Shengavit, where, because of the construction of the walls from river boulders and mud brick, these dwellings come particularly close to the circular buildings revealed recently in the lower levels at Tell Halaf and at Al Ubaid, as well as the settlements of Arpachiyah, Kidish Saghir, and Tepe-Gawra in Upper Mesopotamia.

Lalaian also discovered at Eilar, at the centers of double concentric rings of stones, numerous holes faced with stone and filled with layers of ash containing the remains of human bones, and also a singular hollowed-out stone sarcophagus attributed by him to this same level.

Special significance in establishing the Eneolithic phase in the South Caucasus belongs to the excavations of the Georgian Department for the Preservation of Monuments of Culture, and of the Georgian Academy of Sciences during 1936-1940 at Trialeti, and of the Armenian Department for the Preservation of Monuments of Culture, and of the Armenian Branch of the Academy of Sciences during 1936-1938 at Shengavit.

The first gave stratigraphic material, already partly published,¹⁵ and established a series of ceramic modifications of the Eneolithic layer on the site of the cyclopean town of Akhillar near Beshtashen. This determined the relation of this layer and the usual South Caucasian cemeteries with the blackish-gray ware to the flourishing Trialetian Bronze Age barrow culture with painted pottery and to the preceding culture of the oldest Trialetian barrows. The second excavations made it possible to determine that this settlement belonged to one homogeneous Eneolithic stratum.

The unusual combination in one complex of many types of pottery occurs in the Kiketi tomb and at Trialeti. Here were found heaps of potter's slag and a developed culture emphasized by the skill of the firing. Portable ceramic hearths of a special form, found in Shengavit in an unbroken state in the center of circular buildings, are characteristic of this deposit.

The polished black ware from Shengavit is distinguished by inherent details, strictly peculiar to it, both of shape (the barrel-shaped body and sharply conical narrow lower part of the vessel) and of

¹⁵ Kufiin, B. A., *Archaeological excavations in Trialeti*, vol. 1, pp. 106, 118, and 168, and *About the question of the early stages of bronze culture in the Territory of Georgia*, pp. 13-14, 20-24.

ornamentation (the characteristic development of the drawing in the upper rectilinear geometric frieze and the decorative fretting of the clear-cut outlines of the closed design in relief on the body), so that it may be connected with the comparatively late stage of the Shengavit Eneolithic.

In any event in this connection the finding in Shengavit of a fragment of an oval cup with two bends is significant, being a type well known from the Kizilvank complex with painted pottery, but with the black polishing of the outer surface inherent in the Shengavit types. A cup of this light ware, recalling by its shape a section of a human skull,¹⁶ also came from the excavations by Lalaian on the west bank of Lake Sevan and was erroneously imputed to a Late Bronze Age tomb. There was also a fragment of a similar cup in the upper level of the Eneolithic stratum at Akhillar.

The horseshoe-shaped stands from Shengavit have a special form with a female anthropomorphic figure in the center, in relation to which the bends of the horseshoe play the part of embracing arms. This confirms the connection between these stands and the cult of a female goddess (in the present case, of the hearth) and at the same time may be used as an argument for the hypothesis concerning the origin of the form of the Aegean "horned altars" through the symbolic simplification of the idol of the goddess with the hands held up in prayer. Of other figurative motifs in sculpture the attention is arrested by the sheeplike tailpieces on another kind of horseshoe-shaped stand from Shengavit, by the massive figure of a bull from Shresh-Blur, and also by a kind of hearth stand and separate rude sculptures of animals and man.

The flint inventory from Akhillar and Shengavit included arrows, knives, sickle-teeth, and especially perforated stone implements. In addition, a fragment of a wedge-shaped ax and a marble cask-shaped hammer have particular significance in dating this level. Metal was very rare and consisted of small fragments of pins and of a copper awl, rhombic in outline, characteristic of the early stages of copper production.

The survey of these data, unusual for the South Caucasus, makes it possible to establish the existence, at the dawn of the knowledge of metal or at least prior to the third millennium B. C., in the central part of the Kura-Araxes basin of a cultural layer absolutely homogeneous from Karakurt to Nakhichevan and from Tbilisi to Ararat. This level is characterized by a ceramic production, finely developed

¹⁶ Cf. Human calvaria from Paleolithic deposits at Le Placard, France. It is suggested that these were used as ceremonial drinking vessels. (H. F.)

artistically and yet archaic, with cattle-raising, agricultural settlements with protective cyclopean walls, circular houses, built with mud bricks, with high flues raised above the hearths, and traces of the cult of the domestic fire and of a female goddess.

The development of artistic pottery took place locally, not in the direction of the application of colored painting (Tell Halaf, Samarra, Al Ubaid, Elam styles), but along the lines of the refined use of the still earlier traditions of black polishing and of a gutterlike design of the pottery. This had a pink inner surface of the type from Sakchegozy and proto-Hittite Akhlalibel near Ankara, with its suspected western connections on which depend the peculiarities of the South Caucasian Chalcolithic stage. For example, here developed the spiral motif, foreign to Mesopotamia; the unusual restriction of the design to only one side, the front of the vessels, springing perhaps from the facial urn of western Asia Minor; the presence of earthenware hearth stands of the Alishar and Aegean "horned altar" type; and finally, partly the construction of "tholoi," which are completely absent, for example, in the corresponding lower layer of Persepolis.

All this taken together changes radically the customary historical perspective and opens up new possibilities for the understanding of the early processes of the cultural and ethnic formation of the South Caucasus. This throws light on the conditions causing the appearance of the brilliant cultural rise in the Middle Bronze Age, revealed in Trialeti, and on the proposition made by Kuftin concerning the aboriginality of Georgian culture in the Caucasus.

ARMENIA

Georg Goyan reports¹⁷ from Yerevan that his recent researches on the history of ancient Armenian drama reveal that in 58 B. C. the theater was on a high professional level, performing in both Greek and Armenian, the latter being the official language during the reign of Tigranes. Plutarch, for example, recorded that Euripides' "Bacchante" was presented in Artashat in 58 B. C. in honor of the victory of the Armenians and Parthians over the Roman legions of Marcus Crassus. Excavations are now in progress.

DON REGION

Tsymliansk gorodishche.—The Sarkel expedition of IIMK, under the leadership of Liapushkin,¹⁸ resumed work in 1939 after a 3-year

¹⁷ From the Moscow News, February 9, 1946.

¹⁸ Liapushkin, I. I., in *Kratkie Soobshcheniia*, No. 4, pp. 58-62.

interruption on the right bank of the Don River, 8 kilometers below Tsymlianskaia Cossack settlement. This *gorodishche* was located on a platform, 70.0 m. above the river level, formed by the delta of two ravines. This highly fortified *gorodishche*, commanding the important waterway connecting the steppes with the cities beside the Sea of Azov and the Black Sea and with the Caspian by way of the Volga, existed from the eighth-tenth centuries.

Three cultural levels were uncovered. The lowest stratum was well preserved because of a sterile layer (clay floor of a building); the few finds included iron slag, bones of animals, and some hand-made pottery. Of particular interest were the remains of a dwelling of the semidugout type, probably a conical structure of yurt type. The lower part consisted of an oval pit (2.5 x 1.8 m.), plastered with clay on the walls and the floor, and with a round hearth pit at the north wall. Hand-made pottery, largely flat-based pots with slightly convex walls and sharply flaring lips decorated with notches of the type known from Maiatskaia settlement, was found both inside and outside the dwelling.

The second period is represented by ruins of brick and mortar buildings, very similar to those of the left-bank site where stands the Sarkel *gorodishche*.

To this period also belong the remains of strong fortress walls, 4.5 m. thick with round towers, built of dressed white limestone.

The finds of the three upper levels are very closely related. The pottery, almost entirely wheel-made, was represented by the following types: (a) pots with incised linear and wavy ornament; (b) various shapes of polished ware of Saltovo type; (c) egg-shaped amphorae; and (d) unornamented well-made pots of hard gray clay.

This second period was also characterized by a profusion of iron objects including arrowheads and spearpoints, bits and stirrups, and various implements such as knives, fragments of buckets, sickles, axes, fishhooks, and others. Among personal ornaments were beads, fragments of metallic mirrors, an earring, and several belt buckles. All pottery and objects from this period have analogies in the finds from the Saltovo and Maiatskaia sites and burials. The existence of the second period was terminated by the destruction of the fortifications. In the third period the building materials from these fortifications were widely utilized in construction. This destruction could have occurred during the capture of the Khazar city of Belaia Vezha by Sviatoslav Igorevich, Prince of Kiev, in the year 965, as recorded in one of the old Russian chronicles. This identification of the right-bank site with the Belaia Vezha city had been anticipated by M. I. Artamanov.

The third period is characterized by yurtlike semidugout dwellings closely related to those of the first period. Their remains consist of clay-paved circular or oval shallow pits, occasionally double, 2.5-3.0 m. in diameter, with a hearth in the middle. Many of the dwellings contained human skeletons in various positions, showing no signs of orientation or proper grave inventories. On the other hand, the finds from many of the dwellings were numerous and variegated. Iron was widely represented by such objects as fishhooks, chisels, scythes, plowshares, spades, sickles, and others. Most of these were found in the dwelling pits which had been filled by bricks, fragments of mortar, stone, mineral, and fishbones, and potsherds.

The abrupt cessation of the third period probably occurred during one of the invasions of the steppe tribes at the end of the tenth or at the beginning of the eleventh century, at which time, after the downfall of the Khazar Kaganate, these nomads were undisputed masters of the South Russian steppes. Some traces of an attempt to repopulate and even to refortify the *gorodishche* at some later period were also found.

These materials are of great importance for the understanding of the settling of the nomads in the southeastern steppes which had begun during the ninth century (cf. yurts with agricultural equipment) and also for uncovering the character of the colonizing movement of the Russian Slavic tribes to the southeast, which was begun with the breaking up of the Khazar Kaganate during the tenth century.

VOLGA REGION

NOVO-AKKERMANOVKA CEMETERY

The Archeological Expedition from Orsk, organized by G. Podgaetskii¹⁹ for the Marr Academy of the History of Material Culture and the Museum of Regional Studies at Orenburg, studied during 1936 a Bronze Age cemetery situated 27 kilometers west of Orsk near the village of Novo-Akkermanovka.

The tombs were indicated on the surface by 19 stone boulders arranged in a circle and belonging to 13 burials found at a depth of 0.3-1.0 m. In two cases it was possible to determine the limit of the graves: No. 4 was 0.6 x 1.6 m., and No. 13 was 1.3 x 1.8 m.

The skeletons were lying on the right or left sides with legs and arms flexed and the skull facing west. Nos. 4 and 8 were double burials. The unnatural position of skeleton B, which was that of a

¹⁹ Podgaetskii, G., in *Materialy i Issledovaniia po Arkheologii SSSR*, No. 1, p. 82, Moscow, 1940. Résumé in French.

woman, placed beside male skeleton A in Burial No. 4 suggests the idea of immolation *in situ*.

On the pillow of the deceased had been placed one or two clay vessels. The remainder of the grave furniture consisted of a small copper rod, a sculptured shell, phalanges of horses and sheep (No. 13), 16 sheep astragals and 1 shell from No. 4, recalling bone rings with two openings from Bronze Age burials north of the Black Sea. In addition, in No. 5 were several horse bones, the remains of food placed in the grave.

The character of the grave furniture and the form of the vessels attributed this cemetery to those of Andronovo type whose area extended during the second half of the second millennium before our era across the steppes stretching from the Yenisei to the Urals. In the southern Urals cemeteries of this type present a series of peculiar traits indicating the impact of Western and Eastern cultures.

KOCHERGINO CEMETERY

During 1929-1930 this burial site, situated near Kochergino (Dubrovno) on the Nemda River in the Sovetskii District of the Kirov region, was excavated.²⁰ Five burials were unearthed. Grave No. 3 contained the skeleton of a young man, 25 to 30 years of age, and No. 5 was that of a child 4 to 6 years old. In graves Nos. 1-2 there were traces of incineration; No. 4 contained no bones. The uniformity of the material provided by the different burials permits no chronological subdivisions. These burials were made within a 50-year interval during the period from the ninth to the twelfth century—in order to be more precise, to the end of the tenth or the beginning of the eleventh century of our era.

UPPER VOLGA

According to Tretiakov, from 1933-1937 extensive archeological work was carried out in the region of the Upper Volga. As a result, it became possible to trace a picture of the historical evolution of the region during the first millennium. The explorations encompassed both banks of the Volga for a stretch of more than 350 kilometers, from the mouth of the Dubna (Ivanikovo) to that of the Kotorosli (IARoslav) and the banks of its affluents, including those of Mologa and Seksna, whose valleys were explored for a distance of 100-120 kilometers upstream.

²⁰ Talitskii, M., *Le Cimetière de Kocergino*, in *Materialy i Issledovaniia po Arkheologii SSSR*, No. 1, p. 168, Moscow, 1940. Résumé in French.

These explorations led to the discovery of more than 200 sites of varying degrees at antiquity. Remains of Epipaleolithic and Neolithic sites were found, as were *gorodishches* and *selishches* of the first millennium B. C. and the first millennium A. D., and dwelling places and cemeteries of the second millennium. Large-scale excavations were carried out on more than 25 of the sites. Several of them were entirely uncovered.

Before the first millennium B. C.—Tretiakov outlines briefly the early history of the Upper Volga Valley, remarking on its recent, postglacial age. He mentions the Epipaleolithic sites of a higher Sviderskian character, found near Sobolevo and Skniatino. During the Neolithic period the population was concentrated in three low plains: (a) near Kalinin; (b) along the lower reaches of the Mologa and the Seksna; and (c) along the lower reach of the Kostroma. In all these three areas, numerous Neolithic stations are known, as are sites of the Bronze Age. Outside of these low plains, other stations occur on the shores of large lakes as, for example, Nero, Pleshcheevo, Galic, and Cuchloma.

At the end of the second and at the beginning of the first millennium B. C., the inhabitants of the Upper Volga region emigrated from the low plains to higher ground. This migration was in accordance with modifications which had occurred in the economic sphere, when there was a transition from the hunter-fisher economy to that of agriculturist-livestock raiser.

The character of the dwelling sites was also soon modified. Instead of open sites, the population began to construct small fortresses (*gorodishches*). All these changes in the culture of the early inhabitants of the Upper Volga region were connected closely with the changes that were occurring in the social order, exemplified by the transition from matriarchy to patriarchy.

The first fortified sites appeared in the Upper Volga region toward the middle of the first millennium B. C. The materials found in the earliest *gorodishche* were completely in accordance with those of the earliest Bronze Age sites, thus proving the existence of a genetic link between the former and the latter. The three earliest *gorodishches* were: (a) near the village of Gorodisce, in the suburbs of the city of Kaliazin; (b) near the village of Gorodok, downstream from the town of Myskin; and (c) at the mouth of the Nerlia, upstream from Kaliazin. *Gorodishches* dating from the end of the first millennium B. C. have been found in many places. In this group are the Toporok *gorodishche* and one in the outskirts of Borok, etc. Their antiquity has been determined as a result of the repeated finding of bronze

objects similar to those from cemeteries in the Kama region of the higher and lower Pianobor types.

The *gorodishches* of the first millennium B. C. were of limited size. The dwellings were built on the ground. Among the inventory, apart from sherds and bone objects, were stone and metal implements and some ornaments. Remains found in even the oldest *gorodishche* establish the complete ascendance of animal raising over hunting. The horse and the pig were the principal domestic animals. Numerous hand mills confirmed the existence of agriculture.

The Upper Volga *gorodishche* can be somewhat distinguished from those of the Kostroma section of the Volga by the form of the dwellings and the pottery. This suggests the existence of two separate tribal groups. Moreover, exploration in this region has shown that a considerable length of the Volga, from the mouth of the Mologa to that of the Kotorosli and the section which lies between the sites of the two tribal groups, was uninhabited at that time.

At the beginning of the first millennium A. D.—Some of the inhabited sites of the first centuries of our era have been excavated. An examination of all these sites, together with their chronological classification, permits the following conclusions to be drawn:

(a) That sites dating from the first centuries A. D. are represented mainly by the remains of fortified sites (*gorodishches*). Many sites of this type are even older (first millennium B. C.).

(b) From the second and third centuries, open sites (*selishches*) were found.

(c) Both types were distributed on the banks of the Volga and its tributaries in compact groups of two to four, which indicates clan grouping and consequently denotes the existence of clan territories. Tretiakov brings ethnographic examples to the support of this theory.

Each locality belonged to a definite patriarchal community whose primitive economy, while multiform, also had a collective character. The main branches of production were the raising of livestock and cultivation in clearings. Hunting and fishing were also carried out. In nearly every *gorodishche* and *selishche* were found traces of iron founding and copper smelting. Commercial relations were barely developed at that period, either between localities or more distant areas.

Tretiakov again comments on the presence of certain distinctions between the population of the Upper Volga and that of the Kostroma sector of the Volga.

A fourth-fifth century gorodische on the Sonochta River.—In 1903 A. A. Spitsyn discovered a *gorodishche* at the mouth of the Sonochta

River, which flows into the Volga 20 kilometers downstream from Rybinsk. This site was destroyed by fire, and it is for this reason that its archeological strata preserved a rich fund of material as well as the remains of burnt construction. This site, which covered an area of more than 2,000 square meters, has been completely excavated.

This *gorodishche* was built on a small eminence of the Sonochna alluvial terrace. Its irregular triangular surface was surrounded by a wooden wall and earthen defense works. In the center there arose a wooden house (5 x 8 m.) which was apparently a public building. Around it six dwellings were distributed. These dwellings were small log cabins (3 x 5.4 x 6 m.) with hearths near the rear walls. The left side of each house was reserved for the men, and there the axes, arrows, fishing tackle, harness, and similar articles were kept. The right side was for the women, and during excavation, pottery and knives were uncovered.

Near the central house, there was a small building without a hearth which was used as granary and mill. Hand mills were also found here. Next to it was a forge which consisted of a solid shed with an enormous hearth in the center. In addition, a quantity of iron fragments and several dozen iron ingots, which had been smelted with bellows, were found.

Opposite the main house there was another shed with a small hearth in one corner. Both this shed and the one already described were probably surrounded by light wattle walls. This latter shed was reserved for use by the women, indicated by the finding of numerous slate distaffs, iron bodkins, a needle, and stones used as pressing irons.

The last of the buildings was a mortuary which gives a very clear insight into the funeral practices of the inhabitants. When a member of the community died, he was cremated elsewhere. The calcified bones were then collected and deposited in the wooden mortuary (2.25 x 2.25 m.), which was located opposite the communal house. Excavations among the ruins brought to light a quantity of calcified bones of adults and children, both male and female, and also five iron axes, knives, arrowheads, and iron and bronze rings and ornaments.

The excellent state of preservation and the richness of the remains, since only bone objects disintegrated, revealed a graphic picture, which is probably typical of all the other Upper Volga sites of the first half of the first millennium. The material found gave a relatively complete picture of the life and activities of the inhabitants. The Sonochna *gorodishche* can be assigned definitely to the fourth-fifth centuries as a result of finding enameled objects of the same type as

those from the Riazan cemeteries, and a characteristic clasp in the form of a crossbow which probably originated in the south of the Baltic region.

Middle and second half of the first millennium A. D.—Tretiakov describes several sites contemporary with that on the Sonochta and others of a later date. Toward the middle of the first millennium, the open site, without fortification, became the dominant type. Simultaneously with the change in form the layout of the sites was modified, and they were no longer grouped as before.

All this would indicate a social change in the Upper Volga region after the middle of the first millennium. This was probably connected with the disintegration of the ancient social order based on the patriarchal clan. It would appear that it was at this time that the clan territories began to disappear. The considerable increase, often threefold or even fourfold, in the area of the sites indicated that by the sixth-seventh centuries the localities were no longer inhabited by a single patriarchal community.

Important excavations have been made at: (a) a fourth-fifth century site near the Krasnyi-Cholm Rest Home; (b) a fifth-sixth century site at the mouth of the Iti River, near Uste; and (c) a sixth-seventh century site on the outskirts of Kilino.

These excavations have given a more factual picture of the historical progression during the middle and second half of the first millennium; certain characteristics having already been given above.

At the beginning the inhabitants of every locality worked iron and copper to make themselves tools and ornaments. After the middle of the first millennium there were certain localities engaged in mass production, destined not only for internal use but for purposes of exchange. For example, the inhabitants of the Sonochta *gorodishche* worked iron on a large scale and in the Krasnyi-Cholm *selishche* numerous traces of copper working have been found. On the other hand, the inhabitants of other sites appear to have been consumers.

A second important characteristic of this period was the appearance of agriculture on previously cultivated land, which replaced the former system of cultivating only virgin territory. This is indicated by the increase in the size of the localities and by changes that took place in the methods of livestock raising which show the use of horse traction in agriculture. Finally, there were changes even in shape and size of the implements and tools bearing on agriculture, particularly in the appearance of very large hand mills. This transition led to the rise of a type of allotment economy. The development of trade with neighboring and remoter regions also played a certain role in

the historical progression. This is shown by numerous imported articles, such as enameled articles from the middle section of the Dnieper and articles from the central stretch of the Oka.

The evolution of the funeral rites gives an equal insight into the decline of the clan society. Instead of the clan burial grounds, of the type exemplified by the "burial house" of Berezniaki, after the sixth century A. D., we find funeral monuments in the Upper Volga in the form of elongated kurgans. These are also found along the Upper Dnieper and Upper Dvina and, as a result of recent study, are said to belong to the Slavic Krivichi [Crivici] tribe.

This would indicate that the prehistoric inhabitants of the Upper Volga, as well as those of the Dnieper region, were the ancestors of the eastern Slavs.

During the ninth-tenth centuries, instead of elongated kurgans containing several sepulchers of cremated remains, individual funeral monuments were found. These round kurgans contained the remains of a single person with identical cremation procedure.

Inhabitants of the region around Lakes Nero and Pleshcheevo during the middle and second half of the first millennium.—The previously mentioned distinctions between the cultural character of the Upper Volga region and the neighboring regions of Lake Nero and Lake Pleshcheevo and the Kostroma sector of the Volga are very clearly defined in the sites dating from the middle and second half of the first millennium. The existence at this time of two different tribal groups is proved by the following:

(a) In the first region, the houses are built on the ground, while those of the latter are half underground.

(b) In the former region, the dead were cremated; in the latter they were interred in the same manner as along the Oka, the central Volga, and the Kama Rivers.

Beside Lake Nero, along the Kostroma sector of the Volga and along the upper stretches of the Kliazma, occur several cemeteries which contain flat tombs. The most important, which dates from the eighth-tenth centuries, lies near the Sarskoe *gorodishche*, in the outskirts of Diabol.

(c) Certain variations may be noted in the type of pottery, ornaments, and other objects.

The inhabitants of the first region belonged to the eastern branch of the Krivichi; the latter to Merian tribes, related to the eastern Finnish tribes of the Volga region.

However, the fundamental characteristics of the historical progression in all these regions were the same. From a detailed analysis of

the objects in the Sarskoe *gorodishche*, this was the first town with artisans. Its existence was a result of the progressive development of the social division in labor and the increasing separation of the crafts from agriculture.

PREVIOUS RESEARCH IN THE UPPER VOLGA REGION

Gorodishche near Kaliazin.—The *gorodishche*, located on a headland on the left bank of the Upper Volga between two deep ravines, is protected by two vallums. It covers an area of approximately 1,500 square meters. The site is of interest because its archeological stratum, which is 3.0 m. deep at certain points, contains the cultural remains of different epochs dating from the middle of the first millennium B. C. to the third-fourth centuries A. D. The upper layers of the *gorodishche* were unfortunately destroyed by a cemetery that existed during the twelfth-thirteenth centuries. Small excavations were made during 1935.

Gorodok gorodishche.—This covers an extensive headland junction of the Gorodetski stream with the right bank of the Upper Volga. Its elevation is separated from the plateau by two ditches. The sides have been heavily eroded by the river. The cultural stratum, which was 30-40 cm. in depth, was completely excavated during 1936. In the lower levels, there were objects dating from the middle of the first millennium B. C.; in the upper levels were articles belonging to the first centuries of our era.

Vladimirskie Khutora selishche.—This site on the right bank of the Mologa River, about 50 kilometers from its mouth, was located on the edge of the first terrace, and is today heavily flooded by the spring waters. The cultural stratum, which lay at a depth of 20-30 cm., was excavated in 1936. Only a few objects were found, mainly pottery dating from the first centuries A. D.

Krugletsy gorodishche.—During 1933 on the right bank of the Volga near Ochotin, about 2 kilometers downstream from Myskin, some traces of this *gorodishche*, which had been almost entirely destroyed by the Volga, were found. The 10 square meters remaining were excavated in 1936. This revealed that the site had been occupied during the first centuries A. D. Typical pottery and some iron articles were found.

Grechov gorodishche.—This site was located on a promontory on the right bank of the Upper Volga, at the mouth of the Grechov, 7 kilometers upstream from Uglie. Its platform has been almost entirely destroyed by the river. At the side of the platform, the

remains of two vallums and a ditch can be seen. All the remaining part of the platform was excavated in 1935. Traces of a charred wooden wall surrounding the *gorodishche* were found, as were holes from the pillars of buildings built above ground. The cultural stratum, which was 50-80 cm. deep, yielded articles which dated from the second-fourth centuries. In the upper level, a large bronze buckle encrusted with red enamel was found.

Sonochta gorodishche.—Excavations during 1934-1935 covered this entire site. The cultural stratum, which never exceeded 35.0 cm., contained remains of buildings in the form of charred beams, pits left by supports, broken stone hearths and the remains of a wooden wall which had surrounded the *gorodishche*. It was possible to reconstruct the character of the defense works as a result of the satisfactory degree of preservation of the wattling which supported them.

Uste selishche.—During 1934 this site, located on the right bank of the Volga at the junction of the Iti, near Uste, 12 kilometers upstream from Iaroslav, was examined. Built on a small promontory arising from the flood terrace of the Volga, it had been heavily eroded by the river, to a point where hardly any trace remained. Excavation of the remainder uncovered a stratum, 80 cm. in depth, which contained the remains of a wooden house destroyed by fire. The house had a hearth which had been dug out of the ground. From articles found, this *selishche* was attributed to the fifth-sixth centuries A. D.

Kilino selishche.—During 1936 studies were made on the remains of a site located on the right bank of the Volga near Kilino, about 25 kilometers downstream from Myskin. Built on the bank of the river barely above the water line, it had been heavily eroded by flood waters. The cultural stratum, 50-80 cm. deep, yielded but a limited number of objects dating from the seventh-eighth centuries of our era.

CENTRAL ASIA

UZBEK S.S.R., 1937-1939²¹

Archeological investigations were carried out mainly by the Uzbekistan Committee for the Preservation and Study of Ancient Monuments (UZKOMSTARIS) with the collaboration of the All-Union and local organizations.

Termez Expedition.—This expedition conducted excavations among the ruins of the Old City of Termez and the ancient site of Airtam, which is situated 17 kilometers east of Termez, on the right bank of

²¹ Received by Henry Field from VOKS on February 3, 1941. World War II delayed publication. Minor editorial revisions have been made.

the Amu-Darya River. Ancient written sources do not mention this place, but judging by the facts that the ruins cover an extensive area and that the artifacts unearthed here are of skilled workmanship, this must have been a settlement of considerable size. The site comprises an elevated portion (250 x 100 m.), bounded on three sides by D-shaped, clay walls; the fourth side is contiguous with the steep bank of the Amu-Darya. The ruins of the settlement, also enclosed by walls, are directly adjacent to this elevated portion of the site.

The excavations were concentrated on the southwestern part of the elevated portion of the site. Several buildings, belonging to a single edifice, constructed of large, unburnt bricks were unearthed here. Those chambers in which a sculptured cornice, fragments of reliquaries, and of an alabaster statue of Buddha were found during the first excavations on the site undoubtedly served for cult purposes.

The adjacent premises, with several hearths and large clay pots (*khumi*) for storing food and water, constituted in all probability the sanctuary kitchen. Two floors, dating from different periods, were unearthed in this sanctuary. Parts of the walls between the two floors were covered with a fine layer of alabaster plastering, differing greatly from the rough clay plaster still preserved above the upper floor.

Thus, two different periods have been established for this building, the first of which was dated by a bronze coin of an unnamed ruler, referring to the first century of our era. Excavations carried on at a still greater depth beneath the lower floor brought to light cultural strata attributed to the latest centuries before our era, in which thin-walled pottery of dark-rose clay coated in red engobé, fired-clay tiles, one of which is stamped with a picture of a deer, were found.

The excavations and the material raised to the surface at Airtam yielded a large number of fragments of clay vessels; thick-walled *khumi*, fired-clay kettles for boiling food, jugs, plates, bowls, saucers, conical vessels for lampions, and other forms. The prevailing type was engobé pottery of brown, cream, and red tones, for the most part without ornament, often superbly burnished and made of a thin mass of clay; there were also specimens of colored, varnished pottery.

The ornaments found on the pottery fall into five categories: stamped, molded, burnished, painted, and incised. The majority of the vessels had been made on a potter's wheel. In several parts of this site were unearthed fragments of pottery-firing ovens and a large mass of clay slag, testifying to the extensive development of local pottery manufacture.

In addition to a rich collection of pottery fragments, the investiga-

tions here have furnished a large number of terra cotta figurines of animals and people, objects of a cult nature, statuettes of marly limestone, and architectural fragments of the same material.

The different periods represented in the cultural strata found on this site, the lower of which should be referred to the last centuries before our era and the upper to the first centuries of our era, point to the fact that Airtam existed for a long period of time.

Excavations were conducted at several points among the ruins of Old Termez. An ancient Buddhist monastery, consisting of a large number of artificial caves and of above-ground chambers was found on the Kara-Tepe elevation. The structures above ground were built of unburnt brick and partly faced in stone. The floor was also of the same brick, coated with clay; the walls had an undercoating of clay covered with alabaster, on which traces of varicolored fresco paintings were preserved. The walls of one of the excavated premises, for example, were bordered in red. A picture showing the lower part of a human figure was still preserved above the border; traces of the feet encased in red footgear and parts of varicolored garments could still be discerned. The painting resembles Bamian art in type.

The caves, dug out at different levels in the sandstone layers of the mounds, were connected by staircases, while caves situated on one level communicated through corridors. The caves consisted of rectangular chambers (7-12 sq. m. in area) encircled on all sides by passageways about 3 m. wide and 13-16 m. long. The height of the corridors and the caves was 1.5-2.0 m. Benches were hewn along the walls of the caves and shallow niches occurred in the walls of the caves and corridors. Arabic inscriptions were found here and there on the walls, which bespeak the fact that the Arabs visited and possibly used these caves for a considerable time after their conquest of Termez. The excavations brought to light several caves of large dimensions, probably intended for public purposes, and other smaller caves evidently for individual use. Coins, pottery, and other finds discovered in Kara-Tepe date from the last centuries B. C. to the first centuries A. D.

The investigations of a suburban palace of the Termez rulers of the eleventh and twelfth centuries consisted in clearing the eastern facade, which made it possible to establish the plan of this building. These excavations also unearthed a water reservoir (70 sq. m. in area and 2.0 m. deep) constructed in the courtyard of this palace complex.

The walls were faced with burnt bricks, which were also used for the base, where there were three steps in each corner. Earthenware pipes with a brick trough running parallel, came to light in the north-

eastern corner. Water apparently flowed into the reservoir both through pipes and trough.

In clearing the northern lateral pavilion of the palace, alabaster was found, together with pieces of colored glass, parts of an alabaster grating, and decorative, oval-shaped glass medallions (5-7 cm. in diameter and 2-5 mm. in thickness) molded from green or reddish glass. The pictures in relief on the obverse of these medallions refer to eight different subjects:

1. An eight-petaled rosette in a double circle, consisting of a center and a row of closely set pearls.

2. A medallion with a Kufic inscription, with floral ornament around the letters and at the edges, the faint inscription reading either "king" or "kingdom."

3. The figure of an animal shown running to the left, encircled by an Arabic inscription which reads "for the most high Sultan Abdul Muzafar Bahram Shah"; this inscription may refer either to the ruler of Ghazni, Emin Addaula Bahram Shah or Masaud ibn Ibrahim (1118-1157), or to Bahram Shah, the son of Imad ad-Dinam, ruler of Termez in 1205.

4. A bird of prey clawing some small animal to pieces.

5. A bird of prey holding an animal in its claws.

6. A lion in a circle.

7. A woman standing beside a horse.

8. A rider mounted on a horse, holding the reins in his right hand, and with a hunting bird on his left hand; the rider wears a crown surrounded by a halo.

Several of these depictions—the bird of prey clawing an animal, the bird holding its prey in its claws, and the rider with a hunting bird—are akin in subject to the pictures on ancient eastern metalware found in the vicinity of the Urals.

One of the groups of the Termez Expedition was entrusted with the task of making preliminary investigations on that part of the site where piles of metal and ash promised interesting finds. The results led to the surmise that this was an artisans' quarter, most probably that of the metal craftsmen of Old Termez. Situated 550 paces from the northeastern corner of the citadel, the metalcraftsmen's quarter occupied an area of 8 hectares, on which there were traces of buildings of unburnt brick, streets, squares, and water reservoirs. Two streets could be traced, one along the eastern and the other along the southern boundary of the quarter. The street to the east divided the quarter from the other section of the site, where the excavations

produced a large amount of clay slag, sherds, and pottery-making tools, all of which indicated that this was a potters' quarter.

Excavations in the metallists' quarter were begun at several different levels. The cultural strata reached a thickness of 5.0 m. The upper layers, at a depth up to 1.5 m., were attributed to the eleventh-thirteenth centuries of our era, judging by the pottery and other finds, while the lower strata belonged to the period of the Kushans. Many more or less regularly formed, palm-shaped pieces of metal weighing from 500 grams to 5 kilograms have been found both on the surface and in the excavated portions. Investigations have shown that pieces of pig iron served as raw material for the metalcraftsmen of Old Termez. The discovery, in the upper strata, of fragments of crucibles (which do not relate to iron production), pieces of alloy, and polymetallic ores, as well as fragments of copperware, all point to the existence of copper fashioning as well as forges.

The presence of jewelers' shops in this quarter has also been proved by the discovery of special furnaces used in this craft. Several buildings were unearthed during the excavations, three of which were evidently used for trading, since they were open to the street on one side; their dimensions were 2.0-2.5 square meters. Behind these premises were located the manufactory buildings, where remains of furnaces, odds and ends of ironware, etc., were found.

Other rooms connecting with the shops served for living quarters, not, apparently, for the shop owner and his family, a fact which would have been inconsistent with the seclusion of family life, but for the apprentices and workers. Fragments of an arch (*azar*), constructed of burnt bricks, came to light beneath these trading premises.

Judging by the pottery and other finds, all these buildings belonged to the eleventh and twelfth centuries of our era. In the lower strata, about 1.5 m. beneath the surface, were found pottery, coins, and other articles attributed to the first centuries of our era, and in addition to these, the very same type of iron moldings as were found in the upper layers, of similar palmlike shape and of varying weight.

The material obtained here indicates that manufacturing existed on the site under investigation during a long period lasting from 1,000 to 1,200 years and that pottery making, the jeweler's craft, glass and copper work flourished in Termez during the eleventh and twelfth centuries.

A separate group of the Termez Expedition investigated the ancient irrigation system along the Surkhan-Darya River within the precincts of the Termez district. Of the right bank of the river were found remains of ancient head structures and canals, one of which,

taking its start evidently from Salavat, irrigated the territory of Old Termez. On the left bank, in the middle reaches of the Surkhan-Darya, traces have been found of very large irrigation canals leading to the southeast, i.e., to the site of Airtam. These canals carried water to Airtam, where traces have also been found of an irrigation canal leading to the north-northwest to join, as it would seem, the canals which have their source in the Surkhan-Darya. It must be observed that the pottery collected on the left bank is very similar to that found in the oldest levels of Old Termez and to the objects from Airtam. These included thin-walled, engobé pottery, fragments of gobletlike vessels, painted *khumi*, etc. The results of the investigations of this section and at Airtam give reason to affirm that the irrigation structures on the left bank of the Surkhan-Darya River, requiring large-scale organized labor for their preservation and upkeep, fell into a state of disrepair and neglect about the middle of the first millennium of our era, a fact which brought about a decline in the life of Airtam and other populated points on the left bank of the river.

Surkhan-Darya Expedition.—This expedition carried out archeological investigations in the Baisun district. During 1938 excavations were made in the Teshik-Tash grotto at a distance of 18 kilometers northwest of the district center, near Machai. A Paleolithic settlement with artifacts of the classic Mousterian period was unearthed here. The grave of an 8- or 9-year-old Neanderthaloid child was also found here. The exceptional scientific interest of this discovery has already been presented in numerous articles and reports and we shall dwell on the 1939 work. The expedition made some preliminary surveys in the vicinity of Baisun, which resulted in the discovery of new artifacts, including some pertaining to the Stone Age. Two corridorlike caves were found near Baisun in Kafan-Dara and Dulta-Khan, with large accumulations of bones of wild and domesticated animals. Fragments of ancient vessels were found in one of the caves. These caves evidently served large beasts of prey as places of refuge, and the bones are the remains of their quarry.

In the Ob-Angor grotto remains of ancient metalwork shops have been unearthed including slag and a smelting furnace in the form of a vessel 2.0 m. in height with openings in the sides for forced draft. This site also produced fragments of tenth- and eleventh-century pottery. Two cultural levels were found buried under stones in a cave situated in the Kurgan-Darya gorge; these strata contained coal-ash accumulations, remains of animals, and worked flints of Paleolithic type. Excavations were conducted in an area of 40 sq. km. near Machai in the Amir-Temir grotto, resulting in the discovery of three

cultural strata. The upper stratum belonged to the later Iron Age, the middle to the Neolithic, and the lowest to the Paleolithic period.

Typical Mousterian remains have been found in the lower levels, closely resembling the Teshik-Tash implements—a hand cleaver, a discoidal nucleus, a scraper, and others. Investigations begun in the Teshik-Tash cave during 1938 have been finished and, like the preceding investigations, these brought to the surface typical Mousterian remains. Of particular interest were the flint points, which resemble those from the Palestine caves. To the east of Baisun in the gorge which leads from the mountain river Temir-Ulde, traces have been found of a Stone Age settlement where evidences of stone implement making and the bones of wild animals have been established.

Zarafshan Expedition.—This expedition engaged in reconnoitering investigations and excavations to the northwest of Bukhara in the Kizil-Kum Desert. The plot of land under investigation, about 500 sq. km. in area, abounds in the ruins of ancient settlements, castles, the remains of ramparts and irrigation channels, and a large amount of buried material. The ruins of settlements and castles, built of unburnt brick (*pakhs*), at the present time give the appearance of mounds (*tepe*) of various forms, which have been rendered shapeless by the action of precipitation, wind, and the shifting sands that have covered a large part of this locality. Several of these mounds (Besh-Tepe, Aiak-Tepe, and others), irrigation channels, and the shapeless remains of clay structures are to be found at the extreme western point of the investigated area, situated in the desert about 40 km. from the boundary of the oasis. Here, as in the rest of the investigated territory, much material was discovered, distinguished, however, by features pointing to a greater antiquity than that procured from the sites located closer to the modern boundary of Bukhara Oasis.

In the district of Besh-Tepe and Aiak-Tepe thin-walled pottery was encountered, finished on a potter's wheel and made of finely powdered clay, hard-fired and frequently coated with red engobé, containing traces of complete or partial burnishing and sometimes with a stamped ornament. In addition to such pottery, the expedition found bronze triple-faceted arrowheads of Scythian type.

The mounds situated closer to the oasis (Dingil-Tepe, Katta, Khudzha-Ishan, Varakhsha, and others) yielded material relating to the period from the eighth to the twelfth centuries of our era, and some mounds which are directly adjacent to the oasis were attributed to the sixteenth-eighteenth centuries.

Excavations were begun on the site of Varakhsha, which was one of the residences of the country's rulers, the Bukhar-Khudats, situated

in the desert 12 km. west of the modern oasis. Excavations were concentrated on the ruins of a large building located on the western side of the citadel which was attributed to the fourth and fifth centuries of our era. This building was constructed of large unburnt bricks. Six rooms were cleared. A number of fragments of stucco carving, marked by various ornamental motifs and diverse methods of execution, were found in the piles of building rubbish which filled one of the rooms. In general, these are carvings in low relief, consisting of geometric and stylized floral ornament, including meanders, rosettes, palmettes of rhombics and crosses, in a geometric pattern. There were also some high-relief carvings, which often merged into sculpture proper. This method was used for depicting different themes and for realistic treatment, such as birds, fish, fantastic beings, a winged horse, a bird with a female head and breast, a male torso, fragments of human figures, trunks of large trees with branches and carved leaves.

A large room with wide clay benches was unearthed in the central part of the building. Traces of a unique distemper painting on clay plaster were found on one of the walls of this room. The wall was divided into two horizontal parts by a cornice. Above the cornice on a vivid red-ocherous background were figures of animals shown moving toward the left: deer, tiger, panther, and horse. The upper part of the picture has not been preserved. Hunting scenes were depicted on the portion beneath the cornice: first come the drivers dressed in short breeches and cloaks, mounted on white elephants; following them are hunters armed with spears and bows. The elephants are sumptuously outfitted in colored saddlecloths and harness. One of the scenes depicts a hunter hurling his lance at a lion who has leapt at him with fangs bared. In another episode a hunter has loosed his arrow at a griffin. The lion is painted in orange-yellow and the griffin in white colors. The contours of the figures are outlined in black and brown; shadow planes and perspective are lacking but the firm painting and the bold strokes reveal the touch of an experienced master. The colors have preserved their freshness, although many portions of the human figures were obliterated as far back as ancient times.

This building, lavishly decorated in stucco work and paintings, is identified with the palace of the Bukhar-Khudats, described by Muhammad Narshakhi, a tenth-century historian, who wrote that this palace, built more than a thousand years before his time, had been repeatedly demolished and restored.

Simultaneously with the excavations of the palace, the expedition carried out some trial trenches, the lower strata of which yielded

pottery and other finds dating approximately to the eve of our era, resembling the material of Besh-Tepe and Aiak-Tepe. These discoveries, including artificial irrigation structures, give reason to assert that the territory investigated was a very populous area even before the beginning of our era, and that on the extreme western portions of the site ancient culture began to die out near the beginning of our era, while the more eastern parts which lay higher in regard to the irrigation systems and closer to the water supply—the Zarafshan River—continued to exist up to the eighth-twelfth centuries.

The reasons for this decline can be found in the upheavals brought about by the dissolution of the slave-owning society, the new feudal aspects of social relations and the resultant neglect of the important irrigation system, all of which was supplemented by the intensive advance of the sands of Kizil-Kum on the Bukhara Oasis.

Langi-Iul Expedition.—This expedition continued investigations at Kaunchi-Tepe and also began excavations of the tumuli located nearby. This group of barrows, consisting of about 1,000 burials, spreads over a distance of several kilometers on the watershed between the Chirehik and Boz-Su Rivers. The barrows are of various sizes, from 0.4 to 5.0 m. in height and 8 to 30 m. in diameter. Twelve barrows were cleared, all of which, judging by the grave furniture, refer to three epochs.

A typical flexed burial was found in one of the cleared barrows, about 0.5 m. in height and 8.0 m. in diameter. A child's body was found at a depth of 0.8 m. in an oval-shaped pit, the head pointing east-southeast. The skeleton was lying on its right side, arms bent at the elbows, the wrists placed under the head; traces of violet-colored paint were found on the soles of the feet. At the head of the skeleton there was a flat-bottomed, wide-necked vessel, hand-made and very slightly fired, 12 cm. high, 13.5 cm. in diameter at the neck, and 9 cm. at the base. The burial ritual and the modeling and form of the vessel date the barrow in the late Bronze Age. Tumuli of this type are well known in the southern part of the R.S.F.S.R. and in the Ukraine, but this was the first example of Uzbekistan.

Another type of burial was represented in one of the barrows, where a group interment was found. The skeletons were lying a tergo, arms extended along the body, and legs thrown widely apart. Pottery, differing both in form and decoration from that found in the first barrow, was found near the skeletons. Narrow-necked vessels with a single handle or none at all, flat plates and jugs almost pear-shaped in form, were discovered here. The jug handles were often fashioned in the form of cowslips. None of these vessels was made on the

potter's wheel, but they were all hard-fired. Several of them, for example, the jugs, were coated on the outside with red engobé. This type of pottery was often met in large numbers on the Kaunchi-Tepe site, in those strata which G. V. Grigorev refers to the middle of the first millennium before our era.

The remaining excavated barrows all refer to a single culture. The burials were placed in catacombs, the floor of which was from 2.5 to 3.5 m. below the surface. The average dimensions of the catacombs were: length, 2.5 m.; width, 1.5 m.; and height, 1.5 m.

The catacombs were rectangular with vaulted ceilings. A dromos from 3.85 to 5.0 m. long, and 1.5 to 1.9 m. wide in its upper part, led down from the surface to the catacombs. At a depth of approximately 1.5 m., two or three stepped projections from 0.4 to 0.7 m. wide were found along the main and sometimes along the end walls of the dromos, which correspondingly diminished in size. An opening at the lower end of the dromos led to the catacombs. This opening was about 0.8 m. high, 1.0 m. wide and about 0.5 m. deep. Sometimes the opening was closed with unburnt bricks. Most of the burials in the catacombs contained male and female figures. The skeletons lay stretched out on their backs with the heads pointing north. The grave furniture included the following weapons:

(a) Straight, double-edged iron swords, with narrow shafts at the end for wooden hilts, the length of the blade being about 0.8 or 0.9 m., the shaft for the hilt from 0.1 to 0.13 m. long, and the width of the sword about 4 cm.

(b) Double-edged iron daggers, very massive, from 15 to 20 cm. long and about 4 cm. wide, the remains of wooden scabbards to be found on the swords and daggers.

(c) Triple-faceted iron arrows with shafts, and bone facings of bows.

Lying alongside the female skeletons were found a bronze mirror with a handle sheath at the side, the bone top of a back-comb decorated with small carved heads, a bronze arbalest-shaped fibula ring, a bronze bell, bronze wire earrings, a round bead of blue glass, and other objects.

Among the domestic articles the following may be noted: small iron knives with thick butts 8 to 10 cm. in size; earthenware pottery pitchers with a single handle or without handles; and saddle flasks, flat on one side. The pottery had been fashioned on a potter's wheel, hard-fired, and traces of purplish-red paint could be seen on the flasks.

These tumuli were attributed to the third and fourth centuries of our era.

Ferghana Expedition.—This expedition was undertaken in 1939 and had as its objective archeological supervision of the construction site of the Stalin Great Ferghana Canal. Ferghana, the wealth of which was well known to ancient Chinese writers who knew it under the name of Davin, had never been investigated. In view of the extremely sparse archeological data on the Ferghana region, the organization of work on a large scale promised to be of great interest. Archeological supervision was established over the entire 270-kilometer course of the canal, which intersects the Ferghana region from end to end, from Uch-Kurgan to Kani-badam. Numerous trips were made through the territory lying off the main course of the canal, and in this way a large part of the region was covered by a compact network of scouting parties. Excavation work during the building of the canal unearthed several ancient settlements and tribal sites, burials, and artifacts.

Much material was gathered by the reconnaissance parties. These finds for the most part precede the Arab conquest. Among the coins, some hitherto unknown, was a copper coin of the Greek-Bactrian ruler Heliocles dating to the middle of the second century before our era. The scientific purport of these coins is especially great in that they directly coincide with archeological complexes and with definite geographical points. Among the mass of artifacts of various strata, the ancient complex is especially striking since it is found on the entire territory investigated and should be referred to the second half of the first millennium before our era.

Grain grinders were found in this complex, crude hand-fashioned pottery, pitcherlike vessels, flat dishes, jugs with handles in the form of cowslips coated in red engobé, burnished pottery with incised ornament, stone pestles and mortars. The dense distribution of archeological remains throughout the investigated territory and the great extent of the cultural strata of the ancient settlements make them worthy of particular study. In addition to the sites found directly on the course of the canal, 92 adjacent sites were registered. An unbroken cultural stratum stretches for a distance of 8 kilometers from Lugumbek to the settlement of Tiuiachi.

These facts confirm the evidence of ancient Chinese sources concerning the wealth and highly developed agriculture of Davin, which characterize it as a region with a large agricultural population, famous for its splendid horses, wine distilleries, rice and wheat crops, and numerous cities.

Parties following special routes to the north of the canal into the sands of Kuduk-Kum, lying in the center of the Ferghana region,

found numerous remains of ancient settlements, the material from which can be dated to the end of the first millennium before our era and the first centuries of our era.

SOGHDIANA

Grigorev²² has summarized the results of excavations since 1936 of a series of Soghdian sites in the Zarafshan Valley. The exploration by Grigorev and I. A. Sukharev in the Samarkand area, which covered an area of 200 square kilometers between Samarkand and Zarafshan, disclosed the remains of several dozen ancient settlements. The sites of the most ancient period are in the form of a square surrounded by buildings, with a high central hill in the middle of the square. All these settlements were located in a now waterless steppe on the banks of dry streams. The most extensive excavations were carried on during 1936-1939 at Tali Barzu, now identified with ancient Riwdad. At this site six cultural strata, from the second quarter of the first millennium B. C. to the beginning of the eighth century A. D., have been identified.

The earliest stratum, referred to as Tali Barzu I, contained pottery of the type known from various sites in Iran and Turkestan at the beginning of the third millennium B. C. This refers mainly to the stemmed red matte engobé vases from Tepe Hissar and Anau. Other finds included skewer rests ornamented with ram's heads and archaic female figurines dressed in long robes, trousers, high boots, and with "Scythian" caps (probably *bnahtia*).

Tali Barzu II, attributed to the fifth-sixth centuries B. C., was connected with the large fortified building occupying the entire area of the site, or building complex, containing at least 500 rooms. The outer rooms of the apartment served as the city wall. The corners were fortified with multiple towers. A citadel with loopholes was in the center of the complex.

Pottery with ribbon ornament and also with handles depicting animals appears for the first time. Of particular interest were the numerous figurines, some dressed in the typical "Scythian" costume, others in mantles with false sleeves flung over the shoulders (cf. *kuseu* in Afghanistan), and finally in the costume of the Medes (cf. figurines of a king or satrap in crenelated crown and long robe, reminiscent of the Achaemenid kings depicted on the seals in the De Clercq collection).

The later periods of Tali Barzu were not as rich in finds. Tali

²² Grigorev, G. V., in *Kratkie Soobshcheniia*, No. 6, pp. 24-34.

Barzu III belongs to the period following Alexander's conquest, and includes objects showing Greek influence and Greco-Bactrian coins, replacing those with Achaemenid influence.

Tali Barzu IV, attributed to the period from the first century B. C. to the second century A. D., is associated with the invasions of the nomads from western China and Yuechi in the northern part of Central Asia. The few finds are of significance because of the lack of any written sources regarding Soghdiana during this period.

Totally different building techniques were used during reconstruction of the large Achaemenid buildings. Of special interest were several Buddhist images, an inscribed sherd reported to be the earliest known sample of Soghdian writing, the effigy of an equestrian deity, and a hoard of 20 silver coins resembling those attributed to the reign of Antiochus by Allotte de la Fouye, but with a Soghdian legend on the obverse and probably struck in Soghdiana at the end of the first century B. C.

The settlement was destroyed during the period of the Ephthalite domination, third-fifth centuries A. D., but came back to life during the Turkish conquest in the sixth century (Tali Barzu V). A thick city wall was constructed during this period, and a building of very large slabs of clay was erected upon the central mound. The finds, characterized by Sasanian types of ornamentation both in metal and clay, are much better illustrated from two other sites, Kafiz-Kala and Varakhsh. In the former many coins of Chinese type with square perforation but with Soghdian inscriptions have also been found. The latter, in Bukhara Oasis, contained the ruins of a palace decorated with a magnificent alabaster frieze depicting human beings, plants, animals, birds, and fishes. Subsequent excavations at Varakhsh have disclosed a fresco upon the wall of a palace or temple depicting a procession of animals and a hunting scene²³ with an Indian [?] king hunting elephants and griffins. The type of painting, like that of the sculpture at Varakhsh, is more closely reminiscent of Indian than of Persian art.

Tali Barzu VI (end of seventh—beginning of eighth century A. D.) is contemporaneous with the famous Mount site, discovered by Freimann. Glazed pottery appears for the first time during this period of Arabian conquest, and several coins of the Soghdian King Tarkhun (ante A. D. 710).

Bernshtam²⁴ summarizes the results of recent excavations by the

²³ Cf. frescoes in a villa near Ctesiphon (Iraq) described by Ammianus Marcellinus.

²⁴ From a report by A. N. Bernshtam in *Kratkie Soobshcheniia*, No. 6, pp. 34-42.

IIMK jointly with the Scientific Committee of the Kirghiz Republic and the Kazakhstan Branch of the Academy of Sciences in this area to the west of Chinese Turkestan. This area of the ancient nomads, home of the animal style, was not mentioned in the documents collected by Sir Aurel Stein and translated by H. Qeichelt, yet it is known that the main caravan route from the west to Chinese Turkestan crossed the Jetty-Su (Seven Rivers) area and that consequently some important results might be expected here.

The earliest influences from the west described from this area were those from the Achaemenid Empire (sixth-fourth centuries B. C.). Bronze altars and lamps in the Hermitage Museum found in 1937 near Issyk-Kul, but as yet unpublished, belong to this period.

In the following period (fourth-second centuries B. C.) for a short time there appear in the art of the nomads of the northern Tien Shan foothills some elements of Greco-Bactrian art.²⁵ However, these did not affect permanently the art of the nomads, in which the ancient "animal style" soon came back into its own. The Greeks did not penetrate this area, notwithstanding W. Tarn's claims to the contrary, and Greek influence was felt only by the way of commercial relations. During the beginning of the present era new influences from closer at hand replace those of the more distant areas.

A polished wheel-made ware, totally different from the pottery of the nomads, appears (cf. Kenkol and Berkkarin burial grounds), but it is still impossible to decide whether or not it came from Soghdiana or from the oases of eastern Turkestan. More significant, however, are the finds from the various *gorodishches* of this area.

Soghdian inventories are found in the lowest strata of Taraz (Dzhambul) and Krasnaia Rechka. The finds include, associated with pottery and terra cottas, a barbarian imitation of an eastern Roman solidus of the fourth-fifth centuries. While it is still impossible to date the finds from these strata, they definitely belong to the period between the third and fifth centuries. Together with the typical traits of the Soghdian culture, still retaining a strong influence of Greco-Bactrian tradition, these objects also reveal the influences of the style of eastern Turkestan.

In Soghdian tradition were a figurine of Anakhit (forming the handle of a pot) from Taraz, and an oinochoe of Central Asian type. A modeling mold for a masculine head had a Grecian profile and a general resemblance to Gandharan art; the only known analogy to it are the heads of rulers on Greco-Bactrian coins.

²⁵ Cf. Wusun burials described by M. Voevodskii and M. P. Griaznov, *Vestnik Drevnei Istorii*, No. 2, p. 3, 1938.

The first agrarian settlements in this area (Krasnaia Rechka site) are isolated fortified houses of unbaked brick, two or three stories high, of long parallel apartments (1.5 x 2.0 x 8.0 m.) with flat roofs. These are attributed to the period before the seventh century. At Krasnaia Rechka these buildings were ruined and upon them were Zoroastrian burials, of the seventh-eighth centuries. Bernshtam, who disagrees with the first-century B. C. dating for comparable Soghdian finds from eastern Turkestan by Sir Aurel Stein, attributes them to the fifth or sixth century. According to Bernshtam the colonization activities of Soghdiana were not begun until the period of the third-fifth centuries ("the first period of Soghdian colonization in the Jetty-Su"). During this period Soghdian colonies were still isolated culturally and economically in the midst of the Jetty-Su nomads.

From the end of the seventh century the cultural influence of Soghdiana increased both in volume and significance, in crafts as well as in fine arts. A Soghdian version of the favorite Sasanian decorative motif, a dotted circle filled with either a pictorial or ornamental subject, is encountered in a series of sites, in Mongolia (Tola), Kirghizia (Ak Peshin), and Altai (Katanda). One of the examples combined the Sasanian dotted circle with a Chinese ornamental lotus in the center. Quite possibly the imitations of Sasanian platters, obtained by the Saian-Altai Expedition near Yenisei should be attributed to the Soghdian craftsmen living among the nomads.

Soghdian influences on the pottery of this period from Kazakhstan and Kirghizia have been described by Bernshtam (*Vestnik Drevnei Istorii*, No. 4, 1939).

A contributing factor here may have been a second mass migration of the Soghdians, particularly from Bukhara, during the seventh century. To this period belongs the founding of the typical Mawer-annahrān towns with citadel, *shahristan* and *rabat*, in the valleys of the Chu and Talas Rivers in the northern foothills of the Tien Shan. This movement continued during the Arabian conquest of the Jetty-Su during the first half of the eighth century.

To this period belongs the spread of Soghdian writing in this area, and its use for the local Turkish dialect. The oldest examples of Uigurian writing, in Soghdian characters, are the so-called Turgesh coins of the eighth century.

During the ninth century Soghdian culture begins to disappear, and in the Jetty-Su area it become a component part of the culture of Turkish nomads, after the assimilation of Soghdians by the Turkish population. According to Muhammad of Kashgar, the Soghdians adopted the clothes and manners of the Turks, from Balasagun to

Ispindzhab the inhabitants spoke both Soghdian and Turkish, and there were left no people who spoke only Soghdian.

Summary.—Period I (third-sixth centuries) did not result in the assimilation of the Soghdians by the local Turkish populations. The Soghdians engaged in commercial relations with the Turks, but there was no organic intertwining of the Soghdian culture with that of the local nomads.

Period II (from the end of the sixth century) is connected with the emigrations from Bukhara. At the same time this was a period of assimilation of the Soghdians with the Turkish nomads, resulting in complete dissolution of Soghdian culture in the culture of the nomads. This process was completed by the end of the ninth century. Most recent archeological investigations reveal that the second wave of colonization was less “pure” than the first.

Together with the Soghdians in this colonization participated Christian Syrians.²⁶

KIRGHIZ S.S.R.²⁷

In Frunze [formerly Pishpek] the Kirghiz Museum of National Culture is under construction. Designed by V. Variuzhskii in the shape of a large yurt, the building will be decorated with white marble, majolica work, wood and marble carvings, and colorful national ornaments. The exhibits will trace the history of Kirghizia and will include cultural memorials and works of art. About 3,000 persons will be able to visit the Museum at the same time.

A windowless effect is attained by covering the exterior with a protruding diagonal latticework into whose diamond-shaped openings panes of glass are set. Thus, with the circular glass cupola sufficient light filters through into the building.

SIBERIA

KHAKASS A.S.S.R.

During 1940 while a highway was under construction a slice was cut off a small hill near the Power Collective Farm, 8 kilometers from Abakan, revealing the ruins of a house. On closer study the find proved to be the remains of an ancient Chinese house dating back to the period of the Han Dynasty, approximately the first century B. C.

²⁶ Borisov, A. IA., Syrian inscriptions from Taraz. *Izvestia of Kazakhstan Branch of the Academy of Sciences.* [In press.]

²⁷ This summary is based on an article by Nina Riazantseva in the *Moscow News*, June 1, 1946.

Excavations started in 1941 by an expedition sponsored jointly by the State Museum of History, the Institute of the History of Material Culture (IMK), and the Khakass Language and Literature Research Institute, were interrupted by the war. Resumed during 1945 under the supervision of Lydia Evtiukhova, with Sergei Kiselev, Barbara Levasheva, archeologist of the Minusinsk Museum, and other scientists participating, the excavations have yielded some interesting results. Parts of the adobe walls of the building up to 2.0 m. high are still intact. Under the floor run the flues of a central hot-air heating system in the form of channels lined and covered with stone slabs. Although the central heating system serviced the entire building, it was evidently not always adequate in the rigorous Siberian winter conditions, for traces of braziers are still visible on the adobe floors of several of the rooms.

The building was roofed with thick rectangular tiles alternating with narrow curved strips covering the gaps between, giving an undulating effect.

The strips jutted out beyond the eaves, terminating in circular ends bearing inscriptions in Chinese. Translated by Academician Alekseev from stamped impressions made on moist clay, these inscriptions read: "To the son of heaven (i.e., the Emperor) 10,000 years of peace, and to her (i.e., the Empress) whom we wish 1,000 autumns of unclouded happiness."

On the outside the walls of the buildings were faced with square bricks decorated with a fir-tree design.

After 2 years of excavations it has at last been possible to reconstruct the plan of this interesting building. In the center was a large hall with a floor space of 140 sq. m. from which smaller rooms, 28 to 30 sq. m. in size, opened. On the northern and southern sides the rooms were laid out in two rows, and on the eastern and western sides, in one row. Before the building is completely excavated it is hard to say exactly how many of these rooms there were, but in all probability there were about 20 of them.

The plan of the house and the character of the ancient Chinese architecture make it possible to establish that the building was covered by a triple roof with an extra tier over the tallest part of the building, above the central hall.

Hollows are still visible within the walls in each room where columns stood that supported the heavy tile roof.

In the course of excavation, frames from the doors between the rooms were discovered. Beside three doors inside the central hall were found massive bronze handles in the shape of fantastic horned

genii—the guardians of the entrance—with human faces but animal ears and bovine horns, side whiskers and curled whiskers, and mustaches. Through the nostrils of the hooked noses passed the ring which served as the door handle. The facial features of the gargoyles are of European cast suggesting local workmanship.

Other finds included iron axes, spears, clamps, jade pendants and a jade saucer, a gold earring, bronze buckles, clasps, fragments of a pot, and diverse other objects and ornaments.

The plan of the building itself and the finds brought to light among its ruins indicate that Chinese craftsmen built the structure and that Chinese undoubtedly lived in it. All that remains to be established about this building that differs so markedly from all the other dwellings of the time situated on the territory of the Minusinsk basin is to whom it belonged. It is possible that these are the remains of a trading post of Chinese merchants who in the Han epoch penetrated deep into the land of the “northern barbarians.”

There is, however, one detail in the history of ancient Khakassia mentioned by Chinese chroniclers that evokes special interest in connection with these ruins.

In the year 99 B. C. during the fierce battles that marked the period of energetic expansion of the Han empire at the end of the second and beginning of the first century B. C., Li Hwan-li, a renowned Chinese general, suffered a defeat in battle against the nomadic tribes in the north. Surrounded by superior enemy forces he lost some 7,000 in killed and was forced to flee. His grandson Li-Ling, famed for his skill in archery, came to his assistance with 5,000 infantrymen, but he also had to retreat after a bloody engagement. Seeing that further resistance was useless, Li-Ling ordered his men to save themselves, while he himself surrendered. His captors treated Li-Ling with the respect due to his rank and gave him land in the “khyagas” estate inhabited by the ancestors of the present Khakass. He settled in these parts and eventually married the daughter of the nomad chieftain.

Up to the ninth century A. D., according to Chinese chronicles, the Khakass deferred to the descendants of Li-Ling.

Since it is unlikely that the Chinese general would have made his abode in a local yurt or modest wooden dwelling and since there were sufficient Chinese laborers to be found among the refugees and war prisoners, it is quite probable that he built himself a palatial dwelling in Chinese style.

During 1946 Soviet archeologists continued excavation of the ruins of the Chinese palace.

V. MISCELLANEA ANTHROPOLOGICA

INTRODUCTION

This report, which has been delayed by World War II, is based on results obtained by Soviet physical anthropologists together with observations recorded in the Soviet Union during September and October, 1934, by Henry Field, while leader of the Field Museum Anthropological Expedition to the Near East, financed by Marshall Field.

At the conclusion of the compilation of anthropometric data in Iraq and Iran the members of this expedition, then reduced to the leader and Richard A. Martin, later Curator of Near Eastern Archaeology at Field Museum of Natural History,¹ crossed the Caspian Sea to enter the Union of Soviet Socialist Republics at Baku on September 13, 1934.

Their journey took them by train to Tbilisi [formerly Tiflis]; by automobile over the Georgian Military Highway to Daudzikau [formerly Vladikavkaz and Ordzhonikidze]; by train to Rostov, Kharkov, and Dneproges; by automobile to Dnepropetrovsk; and by train to Kiev, Moscow, and Leningrad.

In order to add a link to the series of anthropometric data from Southwestern Asia, in Tbilisi 50 male Yezidis and in Ordzhonikidze 107 males and 50 females from North Osetia were measured, observed, and photographed. In addition, 20 skulls from a tomb in the Dargavskaia Valley near Koban were measured and photographed. In the Osetian Museum at Ordzhonikidze 19 deformed skulls from a site near Nalchik were also examined.

These data, together with photographs by Mr. Martin, will appear under the title "Contributions to the Anthropology of the Caucasus," by Henry Field.

Before the expedition left Chicago, Wallace Murray, Chief of the Near East Division of the Department of State, had been advised of the proposed itinerary. As a result Ambassador William H. Bullitt in Moscow had requested a special entry permit at Baku. The Academy of Sciences of the U.S.S.R. and the All-Union Society for Cultural Relations with Foreign Countries (VOKS) were also asked to assist them in any manner within their power.

During their visit to branches of the U.S.S.R. Academy of Sciences,

¹ In 1943 changed to Chicago Natural History Museum.

museums, and scientific institutions they were accorded every hospitality and facility for the examination and study of collections as well as an opportunity to discuss anthropological and archeological problems with the members of each scientific staff.

After returning to Chicago, Henry Field kept in touch with many of these Soviet scientists, who have forwarded to him, in Russian or in English, summaries of their own research work or that of their colleagues. In collaboration with Eugene Prostov as translator, more than 50 archeological summaries have been published² since 1935.

The compilation of summaries of anthropometric data obtained recently by Soviet physical anthropologists has proved a far harder task, but perhaps one that is no less valuable to those who study the ancient and modern racial problems of Asia and their impacts on America, Europe, and Africa.

Soviet literature in the libraries of Field Museum of Natural History and the Oriental Institute of the University of Chicago was examined by Eugene Prostov, who selected passages for inclusion and supervised the transliterations and the spelling of place names.

Dr. Alexander Sushko, formerly of the University of Chicago, generously assisted with the translation of part of Ginzburg's anthropometric data.

The general arrangement of the articles, each of which must be treated as a separate entity, will be found in the contents.

Throughout the Soviet Union standardized abbreviations for scientific institutions have been introduced and for this reason a list must be appended.

The following abbreviations have been used in this report:

AZH	Antropologicheskii Zhurnal [Anthropological Journal. Quarterly, edited by M. S. Plisetskii].
GOSSTATISTIKA	Gosudarstvennoe Statisticheskoe upravlenie, currently Tsentralnoe Statisticheskoe upravlenie [Department of Statistics].
IAE	Institut Antropologii i Etnografii [Institute of Anthropology and Ethnography of the State Academy of Sciences], Leningrad.
IIMK	Institut Istorii Materialnoi Kultury, Akademiia Nauk [Historical Institute of Material Culture of the U.S.S.R., Academy of Sciences, since summer of 1937; formerly GAIMK], Leningrad.

² In the *American Anthropologist*, *American Journal of Archaeology*, *American Journal of Physical Anthropology*, *American Journal of Semitic Languages and Literatures*, *American Review of the Soviet Union*, *Antiquity*, *Ars Islamica*, *Asia*, *Gazette des Beaux-Arts*, and *Southwestern Journal of Anthropology*. For references see p. 66, footnotes 1 and 2.

MGU	Moskovskii Gosudarstvennyi Universitet [State University], Moscow.
UAN	Ukrainska Akademiia Nauk [Ukrainian Academy of Sciences, formerly VUAN, later ANU], Kiev.
UNKIU	Upravlenie Nauchnykh i Khudozhestvennykh Upravlenii [Russian S.F.S.R. Bureau of Scientific and Artistic Institutions of the Commissariat of Education].
UZKOMSTARIS	Uzbekistanskii Komitet po Okhrane Pamiatnikov Stariny i Iskusstva [Uzbekistan Committee for the Preservation of Monuments of Antiquity and Art], currently known as Uzbekistanskii Komitet po Okhrane i Izucheniiu Pamiatnikov Materialnoi Kultury [Uzbekistan Committee for the Preservation and Study of Monuments of Material Culture], Tashkent.
SREDAZKOMSTARIS	Srednie Aziatskii Komitet po Okhrane Pamiatnikov Stariny i Iskusstva [Central Asiatic Committee for the Preservation of Monuments of Antiquity and Art], Tashkent.
VOKS	Vsesoiuznoe Obshchestvo Kulturnykh Snoshenii [All-Union Society for Cultural Relations with Foreign Countries], Moscow.

While all scientific research is under the supervision of the Academy of Sciences of the U.S.S.R., the greater part of all archeological work is done by IAE, IIMK, UAN, and local governmental bodies for the Study and Preservation of Ancient Monuments, such as UZKOMSTARIS and SREDAZKOMSTARIS.

Physical anthropologists are attached to these museums and institutions. There is assembled under M. Plisetskii, Director of MGU, an excellent staff including G. F. Debets, V. V. Bunak, and, until his death in Turkestan during 1937, A. I. IArkho. In the museum of MGU there are some of the best anthropological exhibits, study collections, and research facilities.

Throughout this report³ the names of physical anthropologists are given in parentheses to indicate the group with whom they worked, e.g., Uzbeks (Vishnevskii).

All words in brackets have been inserted by the editors in order to elucidate the text.

³ Henry Field attended as a guest the Jubilee Session of the 220th Anniversary of the Academy of Sciences of the U.S.S.R. from June 15-July 6, 1945, in Moscow and Leningrad. He accompanied 15 United States scientists on this mission. During 4 weeks he obtained recent information on Soviet anthropology

ANTHROPOLOGY OF THE WESTERN PAMIRS

Ginzburg⁴ undertook to edit unpublished anthropological data collected by N. V. Bogoiavlenskii (d. 1930) during his Central Asian Expedition, 1898-1901, and now in the Moscow University Institute of Anthropology. This report includes some measurements on 554 adult males from the regions of Matcha, Karategin, Darvaz, and the western Pamirs (Rushan, Shugnan, Goran, Ishkashim, and Vakhán). The latter area was formerly part of the Khanate of Bukhara, now a portion of the Mountainous Badakhshan Autonomous Region.

The population of the western Pamirs belongs to the eastern branch of the Iranian peoples, and is subdivided into a number of isolated ethnic groups living in narrow mountain valleys and gorges. In addition to their native tongues, these people use the Tajik [Tadzhik] languages. Their material culture is very close to that of the Mountain Tajiks.

The anthropology of this area was first studied by Maslovskii⁵ during 1895-1899. A decade later came Shults,⁶ whose measurements were discounted by Ginzburg. Then followed Zarubin,⁷ who published only a small part of his data, and Joyce,⁸ who published Sir Aurel Stein's figures.

Joyce considers that the Vakhán Tajiks are the "average" type for this region, and that they are "pure representatives of the Alpine type." Ginzburg disagrees with this classification, and points out that Joyce's figures do not correspond with other descriptions of the Alpine type, such as that of Collignon.⁹

L. V. Oshanin, leader of the expedition from the Uzbek Institute

and archeology which will form the basis for summaries to be published later. However, when he left in October 1947 to join the University of California African Expedition, these publications were turned over to Dr. Hallam Movius, Peabody Museum, Harvard.

⁴ Ginzburg, V. V., *Antropologicheskii sostav naseleniia zapadnogo Pamira* [The anthropological composition of the population of the western Pamirs according to N. V. Bogoiavlenskii's data]. *AZH*, No. 1, 91-114, 1937.

⁵ Maslovskii, S., *Galcha* [Galchas]. *AZH*, No. 2, pp. 17-32, 1901.

⁶ Shults, P., *Zur Kenntniss der arischen Bevölkerung des Pamirs*. *Orientalisches Archiv*, Leipzig, vol. 11, 1912, and *Landeskundliche Forschungen im Pamir*, Hamburg, 1916.

⁷ Zarubin, I. I., *Materialy i Zаметki po etnographii gornyx Tadzhikov, Dolina Bartanga* [Materials and notes on the ethnography of the Mountain Tajiks, Bartang Valley]. *Sbornik, Mus. Anthropol. and Ethnogr. U.S.S.R. Acad. Sci.*, Leningrad, 1917.

⁸ Joyce, T. A., *Note on the physical anthropology of the Pamirs and Amu Darya Basin*. *Journ. Roy. Anthropol. Inst.*, vol. 56, London, 1926.

⁹ Collignon, R., *Mem. Soc. d'Anthropol.*, Paris, 1899.

of Experimental Medicine in 1935, published his report subsequent to Ginzburg's article.

In his preliminary report Bogoiavlenskii¹⁰ distinguishes four anthropological types, usually present as a more or less heterogeneous mixture:

1. The principal type into which the others resolve appears to be closely akin to the Persian. This type is described as being brachycephalic, of medium to tall stature, with straight or convex nose, well-developed beard, and intensive pigmentation.

2. The "Semitic" type is relatively short, with a narrow face, thin lips, a convex nose, and dark pigmentation.

3. This type, which is rarer, is brachycephalic, of medium stature, with a light reddish beard, a straight nose, and light or mixed eyes.

4. This type is characterized by a still darker pigmentation, thick lips, and a very broad nose.

Bogoiavlenskii did not find any Armenoids.

He accounts for these various types not through isolation but as a result of the migration and mixture of various groups, following the theory according to which the Iranian populations were pushed into the mountains by Turkish and Arab tribes.

According to Bogoiavlenskii the basic anthropological type came from Iran; the light type from Badakhshan; and dolichocephalic elements of the southwestern Pamirs are the remains of the Siyakhpush, who once inhabited this region. The population of central Darvaz came from the Iakh-Su River, i.e., from western Darvaz. Bogoiavlenskii bases his conclusions chiefly on the local traditions. His failure to find any "Aryan" elements among the inhabitants of the Pamirs is important.

The following regional variations of physical measurements were recorded by Bogoiavlenskii:

Stature.—Ranges from medium to medium tall with the tallest in Shugnan (168.7) and the shortest in Darvaz (164.52). The distribution in the Darvaz area agrees with the figures given by Joyce: lowest in the Vakhio Valley and in the middle section of Piandzh, increasing southward toward Rushan.

Head length.—Medium; equal in Karategin, Darvaz, and Rushan, decreasing in Shugnan, becoming less in the southwestern Pamirs. These figures also agree with those obtained by Joyce.

Head breadth.—Medium; lowest in Darvaz. Regional variations agree with Stein's measurements, but his figures are slightly lower.

¹⁰ Bogoiavlenskii, N. V., *Verkhoviyak reki Amu Dari [At the headwaters of the Amu Darya]*. Zemlevedenie, 1901.

Head height.—Great. No comparison possible, as various methods were used in 1901 and 1898.

Cephalic index.—Ranges from brachycephalic to hyperbrachycephalic; decreasing from Karategin to Darvaz; approaching mesocephalic in the Piandzh Valley; and increasing southward, from Vanch to the southwestern Pamirs, where it becomes hyperbrachycephalic. This also agrees with figures obtained by Joyce.

Three cephalic index groups were distinguished by Ginzburg; Karategin and the southwestern Pamirs having the largest percentage of hyperbrachycephals; in Darvaz, mesocephaly predominates, the brachycephals being second; in Shugnan and Rushan brachycephals predominate, and are followed by hyperbrachycephals. Dolichocephals are numerically strongest in Darvaz and Rushan (10 percent).

Face height.—Greatest in Karategin; decreases in Darvaz.

Face breadth.—Medium to narrow; least in Karategin.

Facial index.—Varies within the range of leptoprosopy; broadest in Darvaz.

Ginzburg distinguishes four typical regional groups:

1. *Darvas*.—Short in stature; lowest cephalic index, bordering on mesocephaly (because of sharp decrease of head breadth); low and relatively broad face; shorter and wider nose.

2. *Shugnan*.—Tall in stature; high cephalic index; high, fairly broad face; long, narrow nose.

3. *Southwestern Pamirs* (Goran, Ishkashim, Vakhan).—Stature much less than in Shugnan; highest cephalic index; face and nose long and narrow; pigmentation as in Shugnan.

4. *Karategin* (and, partly, Matcha).—Stature slightly higher than Darvaz; cephalic index as great as in Shugnan because of increase of breadth; high, medium broad face of narrow form; darkest pigmentation of eyes and hair.

These groups correspond with Ginzburg's other data and those described by Joyce.

Ginzburg does not agree with Joyce's definition of the Rushan type as "the pure original type" and considers it to be a transitional stage between the Mountain Tajiks and the tribes of the western Pamirs.

Bogoiavlenskii also measured some Tajiks and Arabs in the IAKh-Su Valley.

The Tajiks are tall (168.0), with a higher cephalic index than in central Darvaz, a narrow face and a narrow, long nose, and intensive head and beard pigmentation. The Arabs from IAKh-Su Valley have practically become assimilated with the Tajiks both in language and in culture. Physically, they are shorter (165.6), with a longer and

narrower face, a broader nose, and more intensive dark pigmentation of the eyes.

Bogoiavlenskii also measured seven Afghans, from the left bank of Piandzh in the Afghan portion of Darvaz. This group is very close to the Tajiks from the right bank of the Piandzh, having an average stature of 160.5 and a cephalic index of 80.0.

Summary.—The population of the western Pamirs is relatively homogeneous, belonging to the short-headed Europeoid type referred to by Bogoiavlenskii as the Pamiro-Europeoid type, to which the Tajiks of Darvaz and Karategin belong.

This anthropological type is characterized by medium stature; brachycephaly with relatively small absolute skull dimensions; a rather long face with a narrow, strongly protruding nose, dark pigmentation of hair and eyes, and a well-developed beard.

Bogoiavlenskii has found local variations of this type among which the peoples of Darvaz, who are characterized by a lower cephalic index bordering on brachy-mesocephaly, are to be found at one extreme, while the Shugnani, who are taller and possess a higher cephalic index bordering on hyperbrachycephaly, occupy the other.

Local variations depend on concentration of genes, the latter being due to considerable isolation in this district, where but slight contact exists between adjacent regions.

Anthropological data serve to refute the existence of Nordic race elements among the population of the Pamirs.

IRANIAN TRIBES OF THE WESTERN PAMIRS

During the summer of 1935 Oshanin¹¹ of the Medical Institute in Tashkent obtained anthropometric data on some very small Iranian tribes inhabiting the sources of the Amu-Darya, i.e., the Piandzh and its tributaries the IAzgulem, Bartang, Gunt, and Shakh dara. These Iranian dialects differ so much that the inhabitants of two adjacent valleys cannot understand each other.

Among the tribes of the western Pamirs, often separated from each other by inaccessible mountain ridges, Oshanin measured and examined 231 Shugni of the Shakh dara, Gunt, and Piandzh Valleys, 42 Rushani of the Piandzh Valley, 52 Wakhi from various villages of Wakhan, 13 Bartangi of the Bartang Valley, and a few Ishkashmi and Gorani.

Analysis of the anthropometric data reveals that these Iranian

¹¹ Oshanin, L. V., *Iranskie plemena zapadnogo Pamira* [Iranian tribes of the western Pamirs], text pp. 1-100, 25 plates, many maps, graphs and tables. Inst. Exp. Med., Tashkent, 1937.

tribes belong to the same racial group which is characterized by brachycephalic brunets of medium stature.

This composite type, however, has probably been formed out of different racial elements. The people of the Pamirs have not lived in isolation. In order to solve the question of the racial structure of these tribes it is therefore necessary to compare them with the surrounding peoples.

During 1923-1934 Oshanin measured and observed 3,317 males in Central Asia. Among some groups the measurements were obtained by assistants under his supervision. Anthropometric data on the following peoples and tribes are therefore directly comparable: 100 Kazakhs of Talas, 100 Kirghiz of the Issyk-Kul region, and 100 Kirghiz of Talas; 1,704 Uzbeks and Tajiks of the Duab; 505 Turkoman tribesmen of the Transcaspian steppes; 433 Karategin Tajiks; 202 Jews, immigrants from Asia anterior in the tenth century; and 53 Iranis (Persians), 56 Azerbaijanis, and 83 Baluchis, all immigrants from adjacent regions of Iran.

Part of the material has been published,¹² the remainder being now in press or in preparation.

Oshanin has identified five racial types in Central Asia:

1. Predominant among the Uzbeks and Tajiks, inhabiting the plains and foothills between the Amu-Darya and the Syr-Darya

¹² Oshanin, L. V., *Tysiacheletniaia davnost dolikhotsefalii u turkmen (opyt osnovaniia teorii Skifo-Sarmatskogo proiskhozhdeniia turkmenskogo naroda)* [A thousand years of dolichocephaly among the Turkomans; an attempt to establish the foundations of a theory of a Scytho-Sarmatian origin of the Turkoman people], SREDAZKOMSTARIS, *Izvestia* No. 1, Tashkent, 1926; *Kirgizy iuzhnogo poberezhii Issyk-Kulia* [The Kirghiz of the southern shore of the Issyk-Kul], V. V. Bartoldu [to V. V. Barthold], *Festschrift* published by the Society for the Study of Tajikistan and of the Iranian peoples outside its boundaries, Tashkent, 1927; *Uzbeki Khorezma* [The Uzbeks of Khwarazm], pts. I-II, *Biu. Sredne Aziatskogo Universiteta* [Bull. Centr. Asiatic Univ.], No. 17 (1927) and No. 18 (1928); *Nekotorye dopolneniia k gipoteze Skifo-Sarmatskogo proiskhozhdeniia turkmen* [Some supplementary data toward the hypothesis regarding the Scytho-Sarmatian origin of Turkomans], SREDAZKOMSTARIS, *Izvestia* No. 4, Tashkent, 1928; *k sravnitelnoi antropologii etnicheskikh grupp prishlykh iz Perednei Azii—Evreev i Arabov, i etnicheskikh grupp Uzbekistana—Uzbekov i Tadzhikov* [Contributions to the comparative anthropology of the ethnic groups which have come out of Vorderasien—Jews and Arabs, and of the ethnic groups of Uzbekistan—the Uzbeks and the Tajiks], in Oshanin, L. V., and IAsevich, *Materialy po antropologii Uzbekistana* [Materials for the anthropology of Uzbekistan], No. 1, Tashkent-Samarkand, 1929; *Pamirskaia antropologo—fiziologicheskaiia ekspeditsiia UZIEM* [Physiological and Anthropological Expedition to the Pamirs], *Bull. UZIEM*, No. 4, (5), Tashkent, 1936.

basins, this type must certainly be regarded as belonging to the great European¹³ race (*Homo sapiens indo-europaeus*). This group is characterized by brachycephaly, medium stature, dark color of the eyes and hair (typical brunets), moderate development of body hair, and a rather small nose with a straight or sinuous bridge. In accordance with the center of distribution area of this type Oshanin has called this group "the Central Asiatic Duab" or "*Homo sapiens indo-europaeus*, var. *oxiano-jaxartensis*."

IArkho,¹⁴ on the basis of data obtained by him in Central Asia during 1928-1932, described the same racial type but gives it the name "Pamiro-Ferghanic" (*Homo sapiens indo-europaeus*, var. *pamiro-ferghanica*). Such an isolation of one and the same type by two independent investigators confirms the reality of this type.

2. The second European type prevails largely among various Turkoman tribes inhabiting the Transcaspian steppes from the Caspian Sea to Afghanistan and from the Amu-Darya to Khurasan. This type, characterized by tall stature, dolichocephaly, and dark color of the eyes and hair, has been called by Oshanin, after the center of the area it occupies, "the Transcaspian race" (*Homo sapiens indo-europaeus*, var. *transcaspica*).

IArkho, while isolating the same racial type on the basis of his own data, defined its position among the dolichocephalic European races more accurately, considering it as a variety of the Mediterranean race and classing it within Fischer's Oriental race (*Homo sapiens indo-europaeus*, var. *orientalis* Fisch.).

3. The third European type is prevalent in the ethnic groups that have immigrated into Central Asia from Khurasan and Persian Azerbaijan, i.e., among the Persians, Iranian by their language, and the Azerbaijanis, using Turki language. The characteristics of this type are a medium stature, dolichocephaly, and dark eyes and hair. From the tall dolichocephals of the Transcaspian steppes it differs by much more abundant hair and "Assyroid" [of Western Asia] nasal form. By the morphology of the nose and profusion of the hair growth this type might be included among the Armenoids of Western Asia, but it sharply differs from the latter by its well-pronounced dolichocephaly. IArkho therefore separates it into a distinct type, terming it "the Khurasan race" or "*Homo sapiens indo-europaeus*, var. *khurasanica*."

¹³ Throughout this section Oshanin has used the word "Europeoid" which we have generally changed to "European." (H. F.)

¹⁴ IArkho, A. I., *Antropologicheskii sostav turetskikh narodnostei Azii*. AZH, No. 3, 1933.

4. The fourth European type was brought into Central Asia by immigrants from Asia Anterior. This is the Armenoid type (*Homo sapiens indo-europaeus*, var. *armenica*). In its purest form this type occurs among Central Asiatic Jews. The brachycephalic Europeans of Asia Anterior (Armenoids) are distinguished from those of the Central Asiatic Duab region by more abundant hair and the typically "Assyroid" form of the nose.

5. The fifth racial type is represented by typical Mongoloids (*Homo sapiens asiaticus*). The Mongoloid type is markedly prevalent among the Kirghiz and Kazakhs, who live mainly on the steppes and in the Tien Shan to the north of the Syr-Darya. IArkho, basing his conclusions on his own extensive data obtained among Turki tribes of the Saian-Altai mountain system, distinguishes the following two varieties among the Mongoloids: the Central Asiatic (*Homo sapiens asiaticus*, var. *centralis*) and the South Siberian (*Homo sapiens asiaticus* var. *sibirica meridionalis*). According to IArkho the latter is predominant in Central Asia.

According to Oshanin a comparison between the Iranian tribes of the western Pamirs and the peoples of Central Asia, Iran, and Asia Anterior reveals that the former must be reckoned among the typical Europeans of Central Asia. No Mongoloid features could be traced among these Iranian tribes.

The European types inhabiting the Pamirs undoubtedly belong to the brachycephalic Europeans of Central Asia, taking an intermediate position between the Tajiks and Uzbeks and the Jews, immigrants from Western Asia. In certain characters, such as abundant hair and a high, prominent nose, the European types in the Pamirs are more related to the Armenoids than to the inhabitants of the Duab region.

As to the racial types distinguished by Risley in the population of India, the comparison indicates that only the Indo-Afghan race cannot be excluded from the population of the Pamirs, where it does constitute a very insignificant admixture. On the other hand the distribution of the cephalic index in the regions south of the Hindu Kush suggests that the migration of the brachycephalic Europeans of the Pamirs to the south was more intensive than the migration of the Indo-Afghans to the north, across the barrier of the Hindu Kush. The cephalic index, indeed, among the Chitrali and Mastui reaches 80.26-80.56, while the admixture of dolichocephals to the Iranian tribes is the most insignificant.

Within the limits of Tibet, there is, according to Risley and Turner, only one admixture of Europeans among its Mongoloid population,

namely that of dolichocephals, particularly in the province of Khams. The population of Tibet did not, therefore, take any part in the formation of the racial structure of the Iranian tribes in the western Pamirs.

In eastern Turkestan, as a result of Sir Aurel Stein's investigations, in addition to a Mongoloid type, there has been recognized a brachycephalic European type closely related to the peoples dwelling in the region of the Duab. This same race also inhabits the Ferghana Valley, which is separated from the western Pamirs by the Altai and Trans-Altai mountain ridges and by the plateau of the eastern Pamirs, which are inhabited by the Kirghiz, typical Mongoloids.

Thus, the comparison between the Iranian tribes of the western Pamirs and the peoples of the surrounding countries proves that this region was populated from the west, from Iran. The connecting link was Afghanistan.

On the basis of the scanty historical information, Oshanin states that the western Pamirs appear to have been populated 1,500 to 2,000 years ago by the Iranians, who from the anthropological point of view take an intermediate position between the brachycephalic¹⁵ Europeans of Central Asia and those of Western Asia.

Oshanin then dwells on certain general anthropological problems of Central Asia and adjacent countries:

1. The distribution of the Armenoids of Western Asia and their differentiation into local types. As stated above, the brachycephalic Europeans of the Pamirs, in certain characters, the most important being hair growth and nose morphology, take an intermediate position between the Armenoids and the peoples of the Central Asiatic Duab. They might possibly be considered as a result of a crossing between the two types named, but on the other hand this intermediate position does not necessarily prove the fact of crossing. It is possible, for example, that the Pamir Europeoids may be but a local variety of the Armenoid of Western Asia. Nor is another possibility excluded of their being a certain transitional stage in the racial evolution, and as our knowledge increases, the number of such intermediary stages linking the brachycephals of Central Asia with those of Western Asia may grow.

Studies reveal that among the peoples of Central Asia there occur certain types undoubtedly maintaining the general Armenoid habitus,

¹⁵ On the basis of my measurements in Iran and those compiled from numerous sources the basic element on the Iranian plateau is dolichocephalic. Brachycephaly, however, predominates in the northwestern and northeastern areas of Iran. Cf. Contributions to the anthropology of Iran, Field Museum of Natural History, Chicago, 1939. (H. F.)

but deviating from the classical Armenoid type. Such are the immigrants from Western Asia, the Central Asiatic Jews, who differ by their general Armenoid traits not only from the brachycephalic Euro-peoids of Central Asia, the Uzbeks and Tajiks, but also from the classical Armenoid type in their rounded occiput, rather low and slightly bulging forehead, and less fleshy nose with its considerably narrower base.

Among other peoples the specific Western Asiatic characters, such as abundant body hair and Armenoid features in the structure of the soft parts of the face, combine with an absolutely non-Armenoid, dolichocephalic skull. Such are the markedly dolichocephalic Iranis (Persians) and Azerbaijanis with their abundant hair growth and typically Armenoid form of nose.

It is only when an anthropometric survey of Western Asia,¹⁶ and more particularly of Iran, has been completed, as well as the excavation of accurately dated crania, that we shall be able to attack the problem of the origin and differentiation into local types of the whole racial complex of Western Asia.

2. The second great problem arising in connection with the study of the Iranian tribes of the Pamirs is the distribution of brachycephalic and dolichocephalic European types throughout Asia. If the data obtained by Oshanin and his colleagues are compared with those from India, Tibet, and eastern Turkestan, the Hindu Kush appears as a geographic barrier. To the south there have expanded dolichocephals represented by the Indo-Afghans, which, according to Turner and Deniker, penetrated into the province of Khams in Tibet, and even to Yunan and Szechwan. On the other hand, to the north of the Pamiro-Altai mountain system there have spread brachycephalic Europeans represented by the above race of the Central Asiatic Duab. To judge from Stein's data, this race has also penetrated deep into eastern Turkestan where it forms the basis of the population in oases bordering the desert of Takla-Makan.

In the narrow gorges of the Piandzh, squeezed between the Pamiro-Altai and the Hindu Kush, the brachycephalic Iranian tribes have settled. Their position intermediate between the Armenoids and the peoples of the Duab has already been mentioned.

3. The third problem is that of the Mediterranean race in Asia. As stated above, to the south of Hindu Kush there has expanded the Indo-Afghan race, of which typical representatives are Sikhs, investi-

¹⁶ See publications by Buxton, Coon, Field, Huzayyin, Shevket Aziz Kansu, Keith, Krogman, Pittard, Shanklin, and Bertram Thomas.

gated by von Eickstedt.¹⁷ I. Arkho, in his work¹⁸ on the Turkomans of Khwarazm noted a similarity between the Turkomans on the one hand and the Sikhs of Punjab and the Rifs¹⁹ of Morocco on the other. Oshanin's tables fully confirm this similarity, and the crania obtained by Pumpelly at Anau in 1904 and studied by Sergi show that the Mediterranean racial complex appeared at a very early date in Central Asia.²⁰ In conclusion, Oshanin states that this appears to be a tall variety of the Mediterranean race, which is now represented only by the following separated groups: the Rifs of Morocco, the Kabyls, certain Beduin tribes, the Turkomans of the Transcaspian steppes, and the Indo-Afghan race.

According to N. G. Malitskii's theory, which on the basis of anthropological and ethnohistorical data Oshanin developed into a working hypothesis, the dolichocephalic European type, now common among the Turkomans of the Transcaspian steppes, was in the past an element of the Scytho-Sarmatian tribes, or Sacae, of Central Asia.

MOUNTAIN TAJIKS²¹

There is no uniformity in the descriptions of the Tajiks, owing to the subjective approach of the older scholars. Most of the older and many of the current scholars, basing their conclusions on the Indo-European theory of the origin of the languages, accept the Tajiks to be more or less pure descendants of the "Aryans," who, according to some of the adherents of that theory, originated in Central Asia.

In the majority of the descriptions there is a tendency to idealize the Tajik type, to endow it with positive moral and physical characters, and to contrast it with the other peoples of Central Asia.

Scholars have been attempting to isolate a specific "Tajik." A typical exponent of this school was Shishlov, according to whom the Tajiks are "the most solid basic Iranian type." Shishlov admits that sometimes it is difficult to distinguish the specific Tajik type from the Persian variety and even from the Central Asian Jews, at the same

¹⁷ von Eickstedt, E., *Rassenelemente der Sikh*. Zeitschr. Ethnol., pts. 4-5, Berlin, 1931.

¹⁸ I. Arkho, A. L., *Die Alterveränderungen der Rassenmerkmale bei den Erwachsenen*. *Anthrop. Anz.*, vol. 12, pt. 2, 1935.

¹⁹ Coon, Carleton, *The tribes of the Rif*. *Harvard African Studies*, vol. 9, Peabody Mus. Harvard Univ., Cambridge, Mass., 1931.

²⁰ Pumpelly, R., *Explorations in Turkestan*, vol. 2, pp. 445-446, Washington, 1905. Excavation of Anau was recommenced in 1946. (H. F.)

²¹ Ginzburg, V. V., *Gornye Tadzhiki* [The Mountain Tajiks: Materials on the anthropology of the Tajiks of Karategin and Darvaz]. *Trudy, IAE*, vol. 16, 1937.

TABLE 1.—*Comparison of Shugni and Wakhi with peoples of Eastern Pamirs, Tien Shan, Ferghana Valley, and other Duab Regions*

People	Locality	No.	Giabella- occipital length	Greatest breadth	Cephalic index	Biz. breadth	Observer
Lokai	Uzbeks	67	181	155	86.5	144	Oshanin
Karshi	Uzbeks	200	181	152	84.11	142	Oshanin
Kermine	Uzbeks	95	181	152	84.33	140	Oshanin
Bukhara	Tajiks	163	181	151	84.20	138	Oshanin
Kazakhs		100	188	160	85.20	150	Oshanin
Tajiks		200	185	155	84.04	143	Iarkho
Uzbeks (nontribal)		399	183	155	84.68	141	Iarkho
Kara-Kalpaks		100	186	156	83.76	143	Iarkho
Kipchaks		100	186	156	84.42	144	Iarkho
Kirghiz		296	187	157	83.97	144	Iarkho
Kirghiz		784	189	160	85.15	150	Iarkho
Kirghiz		100	187	159	84.84	149	Oshanin
Kirghiz		100	187	159	85.08	149	Oshanin
Kirghiz		72	187	155	83.34	147	Oshanin
Kirghiz		35	187	155	83.52	147	Oshanin
Kirghiz		37	187	156	83.15	146	Oshanin
Wakhi		52	185	153	85.46	139	Oshanin
Shakh dara		29	184	155	83.83	142	Oshanin
Gunt Shugni		64	183	155	84.50	141	Oshanin

TABLE 2.—Nasal profile

People	Tribe	No.	Concave	Straight	Wavy	Convex
Shugni	Shakhdara	29	0	65.52	13.79	20.69
Shugni	Gunt	64	7.81	40.62	12.51	39.06
Shugni	Piandzh	138	8.70	50.00	8.70	32.60
Shugni	Total	231	7.36	49.36	10.37	32.91
	Rushani	42	14.29	50.00	9.52	26.19
	Partangi	13	15.38	46.17	30.76	7.69
Other Iranian tribes	Wakhi	52	9.60	55.78	15.39	19.23
	Ishkashmi	7	0	57.13	14.29	28.58
	Gorani	3	0	60.67	0	33.33

TABLE 3.—Cephalic index

People	Tribe	No.	Min.	Max.	Mean	S.D.	C.V.
Shugni	Shakhdara	29	77.5	90.0	83.33 ± 0.76	4.11 ± 0.54	4.90 ± 0.63
Shugni	Gunt	64	77.0	94.0	84.50 ± 0.48	3.84 ± 0.34	4.53 ± 0.40
Shugni	Piandzh	138	74.0	93.5	84.12 ± 0.33	3.92 ± 0.23	4.66 ± 0.28
Shugni	Total	231	74.0	94.0	84.25 ± 0.25	3.94 ± 0.17	4.67 ± 0.21
	Rushani	42	74.0	101.0	84.47 ± 1.00	6.48 ± 0.71	7.55 ± 0.83
	Partangi	13	79.0	90.5	83.65 ± 0.88	3.18 ± 0.62	3.80 ± 0.74
Other Iranian tribes	Wakhi	52	75.0	93.0	85.46 ± 0.51	3.72 ± 0.36	4.25 ± 0.42
	Ishkashmi	7	82.5	87.0	85.64	.....	.....
	Gorani	3	...	...	93.5; 83.3; 75.6	.....	.....

time stressing the importance of preserving "this corner-stone [i.e., the Tajik type] for our ethnographical constructions."

Some authors (e.g., Ivanovich) has attempted to identify the Tajiks with the remains of the Nestorian Christians (who lived in Central Asia during the sixth century) or with Slavs, remarking that the Tajiks are blond, have large features, and amiable, frank dispositions.

Other investigators (e.g., Vambery) did not regard the Tajiks as pure representatives of the "Aryans" or of their Iranian branch. Vambery states that it is impossible to consider the Tajiks to be a primary type of the Iranian race; that while their Iranian type is

TABLE 4.—*Grouping according to cephalic index*

Group	Range	No.	Shugni	No.	Rushani	No.	Wakhi
Dolichocephal	x-75.9	3	1.29	3	7.14	1	1.92
Mesocephal	76.0-80.9	34	14.71	8	19.04	4	7.69
Brachycephal	81.0-85.9	94	40.69	12	25.57	18	34.61
Hyperbrachycephal . .	86.0-x	100	43.31	19	45.25	29	55.78
Total		231	100.0	42	100.0	52	100.0

readily apparent to the eyes, their facial characters manifest some alien Turanian traits (broad forehead, wide zygomatic arches, thick nose, and large mouth). Only the inhabitants of Mountainous Badakhshan (Faizabadians) have a more truly pronounced Iranian type.

Danilov does not consider the Tajiks as Iranians. He bases his conclusions partly on the studies of Korsh, who derived the name of Tajiks from the Pehlevi word *tazi*, meaning "Arab," and partly on the brachycephaly of the Tajiks, which Danilov, whose work lay only among the dolichocephalic population of Persia, did not consider an Iranian character.

Other investigators considered the Tajiks to be the resultant mixture of several races. Thus, Virskii considers the Galchas to be a mixed Aryo-Turkish type, preserving certain tribal characters. The Tajiks, according to Virskii, represent a mixture of the Aryan and Turkish races with the Persian and the Jewish types.

Grebenkin, who described the Tajiks of the valleys, states that they do not belong to any established type, but unite in their composition the characters of all the tribes inhabiting the region. "The Tajiks of this region are an amalgam of all the surrounding tribes. . . . This mixture reflects in it the type of Uzbek, Tatar, Hebrew, Gipsy, even Slavic, Arabic, Persian and Indian."

TABLE 5.—Comparison of Shugni with other Iranian tribes

People	Tribes	No.	Stature	G. O. L.	G. B.	C. I.	Min. front. diam.	Biz. br.	Big. br.	Total fac. ht.
Shugni	Shakhdara	29	170.53	184	155	83.33	107.8	142.2	108.1	127.0
Shugni	Gunt	64	167.72	183	155	84.50	108.1	141.4	106.3	122.7
Shugni	Piandzh	138	167.14	183	153	84.12	106.0	140.0	106.9	123.3
	Total	231	167.72	183	154	84.25	106.8	140.7	106.0	123.6
Other Iranian tribes.	Rushani	42	166.41	185	154	84.47	105.7	139.9	106.7	121.7
	Bartangi	13	164.29	151	151	83.65	104.8	137.7	102.4	120.7
	Wakhi	52	164.08	180	153	85.46	107.2	138.8	105.8	121.8
	Ishkashmi	7	165.5	178	152	85.64	106.4	141.0	104.6	120.5

TABLE 5a.—Comparison of Shugni with other Iranian tribes

People	Tribes	Nas. ht.	Nas. br.	Nas. ind.	Ear ht.	Ear br.	Ear ind.	F. I.	Chest
Shugni	Shakhdara	52.9	34.6	65.55	64.1	35.2	54.03	77.5	88.24
Shugni	Gunt	52.0	34.0	65.44	62.0	34.5	55.90	77.5	86.89
Shugni	Piandzh	51.9	34.5	66.40	65.5	34.4	55.29	76.6	85.53
	Total	52.1	34.3	66.00	63.5	34.4	55.42	77.0	86.25
Other Iranian tribes.	Rushani	51.5	34.2	66.70	61.29	34.0	55.67	77.4	85.83
	Bartangi	50.2	34.3	68.60	58.54	32.8	56.23	77.4	85.46
	Wakhi	52.1	34.3	66.20	60.90	33.8	55.37	77.2	85.62
	Ishkashmi	52.0	35.3	68.00	62.57	34.7	55.64	78.5	83.43

TABLE 6.—*Cephalic index of peoples in the Caucasus*¹

People	Locality	No.	C. I.	Observer
Turks	Nakhichevan	151	76.1	Anserov
Tatars	Azerbaidzhan	207	77.6	Various
Kurds	Transcaucasia		77.6	Ivanovskii
Tatars	Aralych	16	77.96	Chantre
Azerbaidzhanis	Azerbaidzhan		78.1	Deniker
Persians	Azerbaidzhan		78.4	Deniker
Kurds	Transcaucasia		78.5	Deniker
Circassians (Mokoch tribe)			78.5	Chantre
Tatars	Azerbaidzhan	19	78.83	Chantre
Yezidis	Yerevan district	20	78.90	Field
Tats	Baku	129	79.2	Deniker
Turkomans	North Caucasus	302	79.3	IArkho
Turks	Gandzha, Azerbaidzhan	230	79.3	IArkho
Azerbaidzhanis	Azerbaidzhan		79.4	von Erckert
Tatars	Yerevan	17	80.11	Chantre
Tajiks	Norachaine	14	80.11	Chantre
Chechens	Ingushetia		80.4	Chantre
Osetes		14	80.5	von Erckert
Gurians			80.5	Chantre
Yezidis	Total in Tbilisi	51	80.58	Field
Osetes	Terek		80.7	Chantre
Khevsurs	Khevsuretia		80.7	Chantre
N. Abkhazians (Abaze tribe)			80.7	Chantre
Kumyks		130	80.8	Debets and Trofimova
Imeretians			80.9	Chantre
Kalmyks			80.9	von Erckert
Edishkul Nogais		145	80.9	IArkho
Edissan Nogais		146	81.0	IArkho
Osetes		16	81.1	von Erckert
Karatchais			81.1	Chantre
Osetes (tall)		20	81.3	Gilchenko
Circassians	Adighe		81.4	Deniker
Osetes		16	81.4	von Erckert
Osetes		300	81.5	Riskine
Azerbaidzhanis	Lake Goktcha		81.6	Chantre
Abazes		11	81.6	von Erckert
Kurds			81.6	Chantre
Yezidis	Lake Van district	22	81.75	Field
Osetes		554	81.9	Deniker
Circassians			81.9	von Erckert
Kabardins	Kuban		82.0	Chantre
Circassians		54	82.05	Kappers
Circassians (Shapsug tribe)			82.1	Chantre

¹ NOTE.—In the compilation of the data on the cephalic index among the peoples of the Caucasus I have used Baschmakoff (1937, pp. 29-31), Rudolf Martin, Gilchenko, IArkho, and the figures quoted in my "Contributions to the Anthropology of Iran." (H. F.)

TABLE 6.—Continued

People	Locality	No.	C. I.	Observer
Circassians (Beslinais tribe)			82.2	Chantre
Osetes		200	82.62	Gilchenko
Osetes			82.7	Deniker
Chechens	Imertia		82.9	Chantre
Circassians	Temergais		83.0	Chantre
Abkhazians	Coastal Abkhazia		83.0	Chantre
Osetes	Terek Valley (7), Koban (10)	17	83.11	Chantre
Mingrelian			83.2	Chantre
Georgians	Georgia	600	83.2	Dzhavahov
Kara-Nogais		188	83.3	IArkho
Embailuk Nogais		176	83.3	IArkho
Georgians	Georgia		83.5	von Erckert
Tatars (Mountain)			83.6	Deniker
Kabardians			83.6	Deniker
Circassians (Natukhai tribe)			83.8	Chantre
Svans			83.8	Deniker
Kумыks			84.0	Chantre
Kara-Nogais	Eastern	156	84.0	Terebinskaia
Nogais	Terek region	108	84.2	Levin
Chechens			84.2	von Erckert
Georgians			84.3	Chantre
Osetes	North Osetia	105	84.60	Field
Balkars		314	84.6	Levin
Lesghians			84.6	Deniker
Kurds (deformed)			84.6	Chantre
Jews		20	84.7	Weissenberg
Osetes	Koban necropolis		84.7	Chantre
Nogais	Khasavyurt region	165	84.8	Terebinskaia
Tats	Daghestan		84.9	Deniker
Nogais			85.0	Chantre
Kумыks			85.0	Chantre
Karachais		211	85.1	Levin
Assyrians		5	85.1	von Erckert
Armenians			85.1	Chantre
Lesghians	Avars		85.1	von Erckert
Jews	Akhalsikh		85.2	Deniker
Turks	Kakh, Azerbaidzhan	201	85.3	Debets
Turks	Nukha, Azerbaidzhan	301	85.3	IArkho
Lesghians			85.5	von Erckert
Armenians			85.6	Deniker
Armenians (deformed)			85.6	Chantre
Lazes			85.6	Deniker
Nogais			85.8	Deniker
Georgians	Georgia		85.8	Chantre
Jews	Georgia	33	85.9	Weissenberg
Nogais			86.0	Chantre

TABLE 6.—Continued

People	Locality	No.	C. I.	Observer
Azerbaidzhanis	Bayazid		86.0	Chantre
Lesghians			86.2	Deniker
Avars			86.4	Chantre
Nogais			86.4	von Erckert
Mountain Jews	Daghestan		86.7	von Erckert
Lazes			86.8	Deniker
Mountain Jews	Daghestan		87.0	Deniker
Lazes			87.3	Chantre
Lazes (deformed)			87.4	Chantre
Jews		43	87.5	Pantiukhov
Lesghians (Avars)			87.6	von Erckert
Lesghians			87.77	Chantre
Assyrians			88.7	Deniker

TABLE 7.—*Stature of peoples in the Caucasus*

People	Locality	No.	Stature	Observer
Ambailuk Nogais		176	162.5	IArkho
Turks	Nukha, Azerbaidzhan	301	162.7	IArkho
Turks	Kakh, Azerbaidzhan	201	162.9	Debets
Edishkul Nogais		145	163.0	IArkho
Kara-Nogais	Western	188	163.1	IArkho
Kara-Nogais	Eastern	156	163.3	Terebinskaia
Turkomans	North Caucasus	302	163.5	IArkho
Nogais	Khasavyurt region	165	163.8	Terebinskaia
Turks	Gandzha, Azerbaidzhan	230	164.1	IArkho
Edissan Nogais		146	164.3	IArkho
Nogais	Terek region	108	164.6	Levin
Turks	Nakhichevan	151	165.1	Anserov
Kumyks		130	165.9	Debets and Trofimova
Balkars		314	166.9	Levin
Karachais		211	167.9	Levin

Kuznetsov mentions that this unity of type of the Tajiks is due to their Turkization, the degree of which differs in various localities.

The absence of sufficient data on the anthropology of the Tajiks caused von Eickstedt to group the Tajiks as belonging to the Turanian type. This is due to his migrationistic theories claiming the origin of European racial types from the "Turanids" inhabiting Central Asia.

Many authors admit the presence among the Tajiks of two or more types, obtained as a result of the influence of one or the other ancient race.

Snesarev points out the great difference between the Mountain Tajiks (from Karategin and Darvaz) and the Valley Tajiks (from Kuliab and Baldzhuan). The former have retained the characters

of the original Iranians with occasional admixture of the "blond Aryan"; the latter are a variation of the Persians with a strong Arabic admixture.

TABLE 8.—*Head length of peoples in the Caucasus*

People	Locality	No.	Head length	Observer
Turks	Nukha, Azerbaidzhan	301	181.9	I Arkho
Nogais	Khasavyurt region	165	182.2	Terebinskaia
Turks	Kakh, Azerbaidzhan	201	183.9	Debets
Kumnyks		130	184.6	Debets and Trofimova
Kara-Nogais	Eastern	156	184.7	Terebinskaia
Nogais	Terek region	168	185.8	Levin
Embailuk Nogais		176	186.8	I Arkho
Kara-Nogais	Western	188	187.1	I Arkho
Balkars		314	187.7	Levin
Edissan Nogais		146	188.8	I Arkho
Karachais		211	180.1	Levin
Edishkul Nogais		145	189.1	I Arkho
Turks	Gandzha, Azerbaidzhan	230	189.9	I Arkho
Turks	Nakhichevan	151	160.0	Anserov
Turkomans	North Caucasus	302	192.8	I Arkho

TABLE 9.—*Head breadth of peoples in the Caucasus*

People	Locality	No.	Head breadth	Observer
Turks	Nakhichevan	151	145.0	Anserov
Turks	Gandzha, Azerbaidzhan	230	150.4	I Arkho
Edishkul Nogais		145	152.7	I Arkho
Edissan Nogais		146	152.8	I Arkho
Turkomans	North Caucasus	302	152.8	I Arkho
Nogais	Khasavyurt region	165	154.2	Terebinskaia
Turks	Nukha, Azerbaidzhan	301	155.0	I Arkho
Embailuk Nogais		176	155.4	I Arkho
Kara-Nogais	Eastern	156	155.6	Terebinskaia
Kara-Nogais	Western	188	155.7	I Arkho
Nogais	Terek region	168	156.4	Levin
Turks	Kakh, Azerbaidzhan	201	156.6	Debets
Balkars		314	150.2	Levin
Karachais		211	160.0	Levin
Kumnyks		130	161.8	Debets and Trofimova

Grehenkin also distinguishes two groups among the Valley Tajiks: Uzbek blood predominated in one of the groups; and Jewish and Persian, with a slight admixture of Uzbek, in the second group.

There are no "pure Tajiks" in the valleys of Central Asia.

Ujfalvy distinguishes three types of Tajiks in Turkestan: Autochthonous Iranians; Persian colonists; and descendants of Persian slaves.

TABLE 10.—*Eye color of peoples in the Caucasus*

People	Locality	No.	Light	Mixed	Dark	Observer
Turkomans	North Caucasus	302	1.1	21.9	77.0	IArkho
Turks	Gandzha, Azerbaidzhan	230	1.5	54.7	43.8	IArkho
Turks	Nukha, Azerbaidzhan	301	1.0	37.9	61.1	IArkho
Turks	Kakh, Azerbaidzhan	201	1.5	32.0	66.5	Debets
Turks	Nakhichevan	151	0.7	41.3	68.0	Anserov
Kumyks		130	8.5	51.2	40.3	Debets and Trofi- mova
Karachais		211	11.0	80.0	9.0	Levin
Edissan Nogais		146	2.1	41.9	56.0	IArkho
Balkars		314	8.0	61.0	31.0	Levin
Edishkul Nogais		145	0.7	42.0	57.8	IArkho
Embailuk Nogais		176	0.0	38.4	61.6	IArkho
Kara-Nogais	Western	188	2.2	44.3	53.5	IArkho

TABLE 11.—*Bizygomatic breadth of peoples in the Caucasus*

People	Locality	No.	Biz. br.	Observer
Turks	Nakhichevan	151	136.0	Anserov
Turks	Nukha, Azerbaidzhan	301	139.1	IArkho
Turks	Gandzha, Azerbaidzhan	230	139.7	IArkho
Turks	Kakh, Azerbaidzhan	201	140.5	Debets
Kara-Nogais	Eastern	156	142.3	Terebinskaia
Nogais	Khasavyurt region	165	143.9	Terebinskaia
Nogais	Terek region	108	145.1	Levin
Edissan Nogais		146	145.4	IArkho
Turkomans	North Caucasus	302	145.5	IArkho
Kumyks		130	145.7	Debets and Trofimova
Edishkul Nogais		145	145.8	IArkho
Balkars		314	146.0	Levin
Embailuk Nogais		176	147.4	IArkho
Kara-Nogais	Western	188	147.5	IArkho
Karachais		211	147.6	Levin

The groups differ greatly in their physical characteristics. Among the "Persian slaves" there are no blonds with blue eyes, but they do occur occasionally among the second group.

Among the autochthonous Iranian group blonds are fairly common, and brown-haired individuals outnumber brunets. Ujfalvy designates the autochthonous Tajiks as the Mountain Tajiks, as different from

the Persian colonists whom he calls Valley Tajiks, although he admits that these divisions are not absolute and not always exact.

It is worth remarking that Ujfalvy, who represents the French

TABLE 12.—*Cephalic index of peoples in the Volga Region*

People	Locality	No.	C. I.	Observer
Mishari Tatars	Christopol region	122	79.5	Trofimova and Debets
Tatars Proper	Christopol region	109	80.2	Trofimova and Debets
Teptiars		112	80.3	Baronov
Kriashen Tatars	Christopol region	121	80.7	Trofimova and Debets
Mishari Tatars	Birsk region	149	80.7	Baronov
Tatars Proper	Elabuga region	146	81.1	Trofimova and Debets
Bashkirs	Birsk region	123	81.4	Baronov
Kriashen Tatars	Elabuga region	103	81.9	Trofimova and Debets
Tatars Proper	Kasimov region	106	82.2	Trofimova and Debets
Tatars Proper	Arsk region	160	82.3	Trofimova and Debets
Bashkirs	Argaiash region	131	83.0	Baronov
Karagash Tatars	Astrakhan region	158	83.6	Trofimova and Debets
Mishari Tatars	Narovehatsk region	175	86.0	Trofimova

TABLE 13.—*Cephalic index of peoples in the Crimea*

People	Locality	No.	C. I.	Observer
Karaims	Crimea	93	82.9	Adler
Mountain Tatars	Crimea	180	84.1	Nasov
Steppe Tatars	Crimea	200	84.8	Terebinskaia
Mountain Tatars	Crimea	300	84.8	Terebinskaia
South Coast Tatars	Crimea	200	85.3	Terebinskaia

TABLE 14.—*Cephalic index of peoples in the Tannu-Tuva Region*

People	Locality	No.	C. I.	Observer
Kemchik	Tannu-Tuva	124	80.5	I Arkho
Seldzhak	Tannu-Tuva	40	83.1	Bunak
Tosingal	Tannu-Tuva	67	83.2	Bunak
Todzha	Tannu-Tuva	57	84.2	Bunak

school, describes the Mountain Tajiks, who, according to him, were the remnants of true Aryans, as the best-preserved, dark pigmented, most brachycephalic type. Ujfalvy states that he encountered many blond Tajiks in the southeastern part of Ferghana Valley, where

TABLE 15.—*Cephalic index of peoples in Siberia*

People	Locality	No.	C. I.	Observer
Beltir	Khakass	119	79.2	IArkho
Koibal	Khakass	41	79.8	IArkho
Shortsi	Khakass	119	80.3	IArkho
Kumandin	Oirot	99	80.3	IArkho
Yakuts	Siberia	440	80.6	Schreiber
Kyzyl	Khakass	128	80.8	IArkho
Teleut	Oirot	56	81.0	IArkho
Sagai	Khakass	106	82.0	IArkho
Maimalar	Oirot	125	82.0	IArkho
Kachin	Khakass	207	82.1	IArkho
Tubalar	Oirot	203	82.4	IArkho
Telengit	Oirot	227	84.4	IArkho
Altai-Kizhi	Oirot	200	84.5	IArkho

TABLE 16.—*Cephalic index of peoples in Soviet Central Asia*

People	Locality	No.	C. I.	Observer
Iomud Turkomans	Khwarazm	107	75.2	IArkho
Chaudyr Turkomans	Khwarazm	200	77.2	IArkho
Mangyt Uzbeks	Khwarazm	80	80.7	IArkho and Libman
Barlas Uzbeks	Turks	100	82.2	Belkina
Kaltai Uzbeks	Turks	100	83.4	Belkina
Uzbeks	Khwarazm	100	83.5	IArkho and Libman
Kara-Kalpaks	Ferghana	100	83.8	IArkho and Libman
Kirghiz	Ferghana	292	84.0	IArkho
Uzbeks	Karshi town	200	84.1	Oshanin
Kara-Kalpaks	Kara-Kalpak A.S.S.R.	303	84.2	IArkho and Libman
Kipchak Uzbeks	Ferghana	100	84.4	IArkho
Uzbeks (tribal)	Ferghana	399	84.7	IArkho
Astrakhan	Kazakhstan	105	84.9	Timofeeva and Debets
Kirghiz	Tien Shan	784	85.2	IArkho
Bukhtarma	Kazakhstan	482	85.3	Baronov
Uzbeks	Shakhraziab town	200	85.3	Oshanin
Chuisk	Kazakhstan	120	85.4	IArkho
Malaia	Kazakhstan	466	85.9	Rudenko
Kurama Uzbeks	Ferghana	672	85.9	IArkho
Uigurs		450	87.1	IArkho

chestnut-haired individuals predominate, and he explains their presence by the mixture of the local population with the original blond element, the Usuns [Wusuns], and partly with the blond Galchas.

Kuznetsov discerns three types of Tajiks:

1. Those with an Indo-European outline of the face, with regular features. Many individuals of this type have prominent ears, nose, and lips; dark, brown, or black eyes of medium size; and abundant dark hair on the face.

2. Strongly reminiscent of the Jewish type, thin skin on the face, large black almond-shaped eyes, aquiline nose; long, wavy, pitch-black beard.

3. A very rare type with light hair and eyes.

Shishlov agrees that the blond mixture came from the outside, but in the distant past, which is borne out by its absence among the modern Persians. The dark type, according to him, is the only typical Tajik type.

Tsimmerman distinguishes two types among the Tajiks of the Pskem Valley:

1. Tall, pale pink skin on the face, which does not become dark brown with sunburn; slender waist, broad shoulders, and, probably, light hair and eyes. (Less numerous.)

2. Not as tall, more darkly pigmented, more rugged build, and dark hair and eyes. (More numerous.)

Many other authors think that Tajiks belong to a firmly established and defined type.

Thus Middendorff (quoted from Shishlov) thinks that the Tajiks have a completely defined, sharply expressed, independent type, and does not agree with the opinion that the Valley Tajiks are a mixture of Persian, Arabic, Uzbek, and even Kirghiz blood.

He describes the Tajiks as very brachycephalic, with dark hair and eyes, with high and large cranium, rounded domed sinciput, noble, broad, and high forehead, protruding browridges, elevated glabella, deep nasal furrow, thick, protruberant, aquiline ("humped") nose, European eyes, and very thick, dark or light chestnut or red beard. Tajiks have large noses, medium-size hands and feet, and thin calves.

Maslovskii thinks that "Tajik" is a collective term. At first this term may have meant a group of various peoples united by a bond of religion who later were amalgamated into a new general type, represented by a clearly defined tribe known as the Tajiks. Maslovskii does not believe that it is possible to determine by means of anthropological measurements the original elements entering into the composition of the Tajik people.

He does not agree with the authors who think that only one people, by mixing with incoming tribes, produced the type known as Tajik, and that this type is represented by the Mountain Tajiks. Together with Barthold, Maslovskii thinks that in the mountains are found not the pure type of Tajiks, but only the various elements, which, mixing in the valley, produced the current tribe of Tajiks.

Maslovskii discerns five such elements, including the Arab, Jewish, Slavic, Armenian, and eastern Iranian types. The last group belongs to the "Alpine" race; according to Maslovskii this group had the greatest share in forming the Tajik type. Maslovskii's data exemplify the metaphysical method of constructing a scheme of the formation of a type: on one side he admits that it is impossible to discern the constituent elements of the type; on the other, he finds them in the mountains, even delineating their geographical boundaries.

1. *Arab type*.—Fan gorge; Samarkand region; Taghana; Hissar region; Iakh-Su River region. These are Arabs who have partly embraced Tajik culture.

2. *Jewish type*.—Widely spread. According to Maslovskii, Afghans belong to this group. Isolated communities of this type are found in the Zarafshan Mountains, in the Hissar and Karategin. This type is particularly pure in the upper course of the Zarafshan River, and in the lower course of the IAzgulem River. A strong admixture of this type is also found in Rushan and Badakhshan, and, partly, in Shugnan. On the basis of philological study, Ginzburg considers that it is impossible to suspect them of Semitic origin.

3. *Slavic type*.—To this type belong tribes of northern Karategin and Darvaz, and a group of mountaineers of Vakhán.

4. *Armenian type*.—On the left bank of the IAgnob River and in the northern section of Hissar and Karategin.

5. *Eastern Iranian type*.—Right bank of IAgnob, Hissar, and Karategin, and along the Darvaz River, from Kalai-Khuban to Vanch. This type forms the basis of the Tajik race.

According to Bogoiavlenskii, representatives of several types are found in each *kishlak* (hamlet). In its basic traits, the population is brachycephalic, and resembles the Persian type. The following are the characteristics of this dominant type: medium to tall stature, brachycephalic brown eyes; long, wavy (sometimes slightly curly) black beard, and a straight (sometimes aquiline) nose.

Another common type, to which belong the majority of some of the settlements, is the "Semitic type," which is characterized by fairly low stature, exceptionally thin lips, brown eyes, aquiline nose, narrow face, and a slightly curly black beard.

A third rarer type resembles Russian peasants with a light reddish beard, medium stature, greenish, sometimes light blue, eyes, and a straight nose.

A fourth type, having a more darkly pigmented body skin, very wide nose, thick lips, widely set eyes, differs greatly from the first three types.

T. A. Joyce, who published the materials collected by Sir Aurel Stein, illustrates the mechanistic approach toward the study of the variegated characters of the Tajiks. Together with Stein, Joyce believes that the best-preserved autochthonous type of Tajiks is found among the inhabitants of Rushan. Under the influence of the other types (wide- and narrow-nosed Turko-Mongol types) this type has changed to the north and south of Rushan.

Ginzburg criticizes this because the geographically central location is taken as the sole reason for considering Rushan as the original type. This type, according to Ginzburg, is also a result of a definite set of changes, and cannot be taken as the ancestral type.

Most of the remaining descriptions of Tajiks have been summarized by Shishlov.

The authors who have studied the Tajiks of various regions point out the difference between the Plains and Mountain Tajiks. Thus, according to Ujfalvy the Mountain Tajiks were more brachycephalic than the Plains Tajiks.²²

According to several authors, Mountain Tajiks are more homogeneous in type than the Plains Tajiks. Thus, Arendarenko states that the types of the Karategin and the Darvaz Tajiks are similar. According to his descriptions, the Tajiks of these regions have swarthy skin; straight, thick hair, black, red, or chestnut; black and light brown eyes; regular, expressive faces; broad, steep, or low forehead, and bold nose.

The variation in the descriptions of Tajiks is due to the fact that the population of different regions was studied. Sometimes the descriptions were affected by the tendentiousness of authors, some of whom (Biddulph and Grebenkin) wanted to represent them as weak, undeveloped, and lacking in endurance, or those who described them as strong, broad-shouldered, and sturdy (Pokatilo).

Even some of the older explorers were known to point out the social, as well as historical and geographical, reasons for the variations of the types of Tajiks. Thus, Biddulph states that in certain localities the "higher classes" show best the admixture of "Aryan" blood.

²² According to Ginzburg this was discovered to be wrong.

According to Grebenkin, the villagers prevailingly belong to his first group (with a greater admixture of Uzbek characters). The author of an anonymous old description of Tajiks states that rich Tajiks differ greatly from poor Tajiks in type, and that the richer they are, the greater admixture of Persian and Jewish blood they seem to have.

Shults points out the considerable difference between the "fine" type of the members of the noble families, most of whom derive from ancient military leaders, and the coarse type of the rest of the population.²³

History of anthropological study of the Tajiks.—Probably the earliest measurements are those taken by A. I. Fedchenko in 1869, who measured 33 individuals, including four Tajiks from Zarafshan Valley. He also brought out several skulls. These materials were published by Bogdanov, who gave a detailed characterization of Turkestan crania, and noted their extreme brachycephaly. The crania studied by Bogdanov were characterized by exceptional height. It is interesting to record that at that time European anthropologists (Topinard and Girard de Rialle) thought that Central Asian Tajiks were dolichocephalic, probably basing their figures on de Khanikhov's materials on the Persian Tajiks. At a later date Topinard studied the crania brought back by Fedchenko,²⁴ and had more correct information regarding Mountain Tajiks.

Ujfalvy measured 58 Tajiks from Koghistan (upper Zarafshan Valley) whom he called "Galchas," 31 Tajiks from Ferghana, 29 from Samarkand, and 10 from Hissar.²⁵

In 1890 Troll published brief data regarding 148 Central Asians, including 6 Tajiks.

In 1894 IAvorskii, who was particularly interested in Turkomans, measured 16 Tajik women. During 1895-1899 Maslovskii measured 583 individuals, of whom 381 were Plains Tajiks (no specified locality), 42 individuals from IAgnoh and Darvaz, 21 from IAngulem, and 34 from Matchin. On the basis of his published figures it is impossible to justify his division of Tajik tribes into five types.

²³ Ginzburg states that such judgments, based on superficial observations, are typical for the adherents of the Indo-Aryan theory.

²⁴ Cf. Crânes Galtchas. Bull. Soc. d'Anthrop., p. 247, Paris, 1878.

²⁵ Ginzburg observes that these materials are too diffuse: great geographical range and differences of age; his claims regarding the common occurrence of light elements among the population have not been substantiated; his methods make it impossible to compare his figures with those obtained by more recent explorers.

In 1898 and 1901 N. V. Bogoiavlenskii made two trips along the upper course of the Amu, together with Bobrinskii and Smirnov.

The object of his trip was the study of the contemporary inhabitants of the Pamirs with a view to finding out whether they were autochthonous, and, if so, of what race; and, if immigrants, their origin. Bogoiavlenskii concluded that Tajiks of the Darvaz are of the Persian (Iranian) race, with a certain admixture of alien blood, and that their ancestors did not live in the mountains, but came from the valley of Iakh-Su under the pressure of invaders.

Bogoiavlenskii measured approximately 600 Tajiks from the valleys of Karategin, Darvaz, and the western Pamirs. Unfortunately, the death of Bogoiavlenskii prevented the conclusion of his labors on the publication of these data.²⁶

The crania from Makshevav caves, brought back by Bogoiavlenskii, were studied by Zograf, who pointed out their extreme brachycephaly.

In 1912 Blagoveshchenskii published brief anthropometric data on 21 Tajiks (15 from Ferghana, 4 from Karategin and Darvaz, and 1 each from Afghanistan and Persia) whom he measured in the Eye Clinic at Marghellan.

Shults collected anthropological materials in the Pamirs during 1911-1912. He thinks that the Tajiks of the western Pamirs belong to an "Aryan" people who came from the west. According to Shults, Pamirian Tajiks are slender, of medium-tall structure, with elongated extremities, small feet and hands, and thin calves. Their faces are elongated, with prominent noses, deep-set, dark, usually brown, green, gray, rarely blue, eyes. Their hair is dark or brown, sometimes light. Skin color is brownish. Yet even a superficial examination discloses later admixtures of alien blood. Thus, the Afghan type manifests itself in a broader face; the Uzbek ("Sart") type in their straight noses and thicker lips; the Hindu type in the occasional strikingly narrow face; the Kirghiz type in high cheek bones. Sometimes the influence of the Jewish and Russian types was observed.

In one of his papers Shults gives the table of individual measurements of 35 individuals from Khorog, yet there was some confusion in the publication of the figures, and it is not possible to use them. Ginzburg's conclusions are obviously based on subjective observations and generalizations.

Sir Aurel Stein, who visited the Pamirs in 1915, states briefly that

²⁶ They were studied and systematized by Ginzburg in 1936, with the permission of the State Institute of Anthropology of the Moscow State University; the anthropometric data do not correspond with the preliminary conclusions reached by Bogoiavlenskii.

the inhabitants of the western Pamirs have best retained their original ancient type. This is particularly true of Rushan where, because of the extreme isolation of the region the purest type of *Homo alpinus* is represented among the Galchas. To the north of IAngulem and Vanch the Turkish element begins to be felt, both in the physical type and in the culture. The material collected by Stein includes 55 individuals from Vakhan, 34 from Shikashim, 40 from Shugnan, 58 from Rushan, 20 from IAngulem, 23 from Vanch, 25 from Darvaz, 26 from Karategin, and 16 Plains Tajiks from the oases of Bukhara.

This material was published by T. A. Joyce, who comes to the conclusion that it is possible to divide the Tajiks from the western Pamirs into two groups:

1. *Northern and northwesterly*.—IAngulem, Vanch, Darvaz, and Karategin: characterized by relative dolichocephaly, narrow noses, euryprosopy, and small stature.

2. *Southern and southeasterly*.—Shugnan, Ishkashim, and Vakhan: relatively brachycephalic, long-nosed, leptoprosopic, and tall.

The Tajiks from Rushan stand between the two types, forming the connecting link. This is explained by the fact that they represent the best-preserved type of the original inhabitant of the region, *Homo alpinus*, which was changed to the north and the south under the influence of the broad-nosed and the narrow-nosed Turko-Mongolian type. Plains Tajiks are also basically *Homo alpinus*, transformed under the influence of a wide-nosed Mongolian type (represented by the Kirghiz). In using the term "Alpine type" Joyce specifies that it does not imply the presence of any sort of kinship between the Pamirians and Alpines, but only a similarity of physical characteristics.

The nasal and facial measurements recorded by Joyce are much smaller than any other, probably owing to the fact that Stein and Joyce were not using the standard methods for this measurement. Joyce's method of mechanically summarizing the coefficients of racial similarity in the presence of small samples may lead to erroneous conclusions.

Several investigators, including Shishlov, Kapusto, and Shirokova-Divaeva, have studied the physical development of school children. Attention is also being paid to the study of blood groups of various peoples of Central Asia (IAsevich, IArkho, Vishnevskii, Petrov, and others). Unfortunately much of the material collected has not been published.

Chronologically, the study of the Tajiks since the Revolution has progressed as follows:

1. In 1925 V. V. Bunak studied the blood groups of the students of the various nationalities represented at the Institute of Oriental Peoples in Moscow. Among these were 25 Tajiks.

2. L. V. Oshanin, in the period between 1925-1927, investigated 433 Tajiks from Karategin employed in seasonal labor in Tashkent. The materials have not yet been published.

3. In 1926 Oshanin examined 100 Tajiks from Bukhara, and published detailed data regarding their racial composition.

According to Oshanin's conclusions, Tajiks belong to an independent "autochthonous" type which he calls *Homo sapiens indo-europaeus* var. *turkestanica centralis*, subsp. *iranoides brachycephalica*, with the focus of habitation within the Central Asian interfluvial region (between the basins of the Amu-Darya and Syr-Darya Rivers). Oshanin believes that this type does not differ from the ethnic groups, but admits the possibility of local variations.

Constitutionally, the majority of Bukharan Tajiks are asthenic, and only a small percentage are pycnic, which, according to Oshanin, points to the paratypical nature of the phenomenon. The general conclusion regarding constitutions is that the types found among the native population are no less real than those of some Europeans.

4. S. Tsimmerman studied, in 1925, 100 Tajiks aged 20 to 80 years, 73 of whom were from Pskem Valley near Tashkent, 19 from Mountainous Bukhara, and 8 from the Samarkand region. Tsimmerman distinguishes at least two types among the Tajiks, and thinks that the Tajik type is very near to that of the Uzbeks (having in view "Sarts" studied by Shishlov in Tashkent). Tsimmerman's materials were taken summarily, and it is possible that the types which he distinguishes came from various districts.

5. In 1926 the Academy of Sciences sent a large expedition into Central Asia under the leadership of Barthold. B. N. Vishnevskii, who was in charge of the anthropological work of the expedition, measured 279 Tajiks aged 16 to 61, from the Pendzhikent region. Blood groups were studied in addition to other physical characters. According to Vishnevskii, the Tajiks of the region are, anthropologically speaking, a variegated group. Among them were observed several Mongolian types. Blue-eyed, fair-skinned individuals were also found along with the ordinary brunets.

According to Vishnevskii, various types are found among the Tajiks, while the most prominent type is that of *Homo tauricus* (O. Reche). Of the individuals studied, 85 percent were mesosomic, 10 percent

leptosomic, and 8 percent eurisomic. Unfortunately, the complete account of Vishnevskii's study has not yet been published.

In 1926 M. I. Gagaeva-Vishnevskia collected anthropological materials on the women of Central Asia, among them 158 Tajiks. The only published results consist of a brief note by Vishnevskii stating that 20 percent belong to the leptosomic type, 75 percent to the mesosomic, 5 percent to eurisomic.

In 1927 G. G. Petrov measured 629 Tajiks from Ura-Tiube and Shakhristan regions and from Samarkand and vicinity. On the basis of the blood group distribution he concludes that the Plains Tajiks have been greatly mixed with the neighboring peoples. Petrov has also published a paper on the muscular strength of Tajiks from the vicinity of Ura-Tiube, and some other materials on Tajiks have been published by him. The bulk of his materials remains unpublished.

A. I. IArkho was in charge of the anthropological work of the Society for the Study of Soviet Asia, from 1928-1931. In 1929 he studied 200 Tajiks from Khasan (Ferghana region). He thought that the Tajiks were Europeoids, and, admitting that the type *Homo sapiens indo-europaeus* is not homogeneous in Central Asia, classifies them as the Pamiro-Ferghan subtype. "This is a brachycephalic type, with a short skull, straight forehead, hair development above medium, straight or slightly convex nose. . . . It is doubtful whether this type stands alone in the European groups. It is probable that it is connected with the short-headed population of Vorderasien and the non-Armenoid population of the Caucasus."

IArkho noticed some variations among the tribal and territorial groups. According to him, the mestization between the Europeoid and Mongoloid types in Central Asia has progressed to such an extent that even the most Europeoid and Mongoloid groups are not lacking characters of the opposite type.

The expeditions led by IArkho have also collected materials bearing on the physical development of the populations of Central Asia. Very little of this material has been published.

Korovnikov, who in 1928 participated in an expedition for the study of endemic goiter in the region of the Vanch River, measured 80 individuals who were not greatly afflicted by endocrine disorders. He recorded data bearing on racial and constitutional characters. With Oshanin, Korovnikov classifies the Tajiks of the Vanch area as *Homo sapiens indo-europaeus* var. *brachymorphus* (Giuffrida-Ruggeri) with pronounced traits of the Iranic type. The eastern Iranian type of Vanch mountaineers, classed as Alpines, is the connecting link between the mountaineers of Europe and Asia.

V. K. IAsevich measured in detail 150 Karategin Tajiks (Garm) and 202 Tajiks from Matcha during an expedition in 1930. This material, cited after a report of Oshanin at the December 1932 meeting of the anthropological section of the IAF, is not known. We have also learned that at the end of 1932 IAsevich investigated the blood groups of 831 Tajiks from Karategin, 1,570 Tajiks from Isfara, and 309 Tajiks from Matcha.

Other yet unpublished anthropological material is known to have been collected by P. K. Arkhibaev in the Kurgan Tiubin and the Kuliab regions of the Tajik S.S.R.

Head length ($M=182.80$) is medium, with regular distribution of variants, and slight preponderance of greater lengths.

Greatest length is found in Karategin; shortest in southwestern Darvaz. There is little difference between Plains and Mountain Tajiks in this respect.

A comparable length is observed among Ferghana (IArkho) and Angren (IArkho) and Tashkent (Shishlov) Uzbeks; also among Shakharsiab and Karshi Uzbeks (Oshanin). The greatest deviation from this length is found among the Mangyt clan of Uzbeks and the Uzbeks from Khwarazm (Khoresm). Samarkand and Karshi Arabs have a similar head length, as well as Central Asian Jews (Oshanin and Weissenberg). Pamir Kirghiz (Joyce) have a similar length, probably because of geographical proximity. The Issyk-Kul, Ferghana, and Tien Shan Kirghiz have a much greater length.

Turkomans have a much greater length, and this is their most pronounced difference from Tajiks. Persians have also greater length. A similar and, occasionally, greatly exceeding length is found among Afghans and Hindus (Risley).

Head breadth ($M=152.55$) is also medium, although greater breadth is found much more frequently than greater length. Karategin region gives a greater breadth than Darvaz. Mountain Tajiks' breadth is less than that of Ferghana Tajiks (IArkho) and Plains Tajiks (Joyce), with the exception of Karategin and Muminabad Tajiks. Bukhara and Pskem Valley Tajiks vary within the same range. Tajiks from western Pamirs also have smaller breadth.

The head breadth of the Tajiks approaches that of Jews, Khwarazm Uzbeks, Shakharsiab, and Karshi Uzbeks (Oshanin), Tashkent Uzbeks ("Sarts") (Shishlov), and Mangyt clan (IArkho). Ferghana and Angren Uzbeks (IArkho) have greater breadth. Pamir Kirghiz have similar breadth, while those of Ferghana, Tien Shan, and Issyk-Kul have greater breadth. Arabs (Samarkand) have similar or greater breadth than Mountain Tajiks. Variety of breadth, greater and

smaller than that of Mountain Tajiks, is found in Afghanistan. Turkomans, Persians, and Hindus have smaller breadth than Tajiks.

Bregma-tragion diameter ($M=127.55$) is great; large deviations occur. This height is greater in Darvaz than in Karategin. It is similar to the height of Bukhara and Pskem Tajiks, less than that of Ferghana.

The head height of Karategin Tajiks approaches that of Central Asian Jews and Shakharsiab Uzbeks; of southwestern Darvaz, approaches that of Uzbeks, Kirghiz, and Turkomans (IArkho). Hindus (Risley) vary within the same range, being occasionally greater.

Tsimmerman's²⁷ claim that the Tajiks' head height stands on the border between medium and small sizes cannot be accepted, as Bunak's scheme is not applicable in Central Asia; according to this scheme, head height is very high, and not medium, if one compares all the available figures from Central Asia.

Cephalic index ($M=83.5$) is brachycephalic with a tendency toward hyperbrachycephaly; only a few dolichocephals have been found. The variations are small, the highest being found in southwestern Darvaz where the head form approaches hyperbrachycephaly. Lowest is found in central and eastern Darvaz. The cephalic index of the Mountain Tajiks equals that of Ferghana, Pendzhikent, and Bukharan Tajiks, and with the population of the western Pamirs (except Ishkashim and Vakhan, where it is higher).

The cephalic index of Mountain Tajiks (Karategin and southwestern Darvaz) approaches that of Kirghiz, Uzbek (except Mangyt) Jews, and Arabs, and differs greatly from that of Turkomans, Persians, Hindus, and some Afghan tribes.

This similarity of cephalic index of Tajiks with other Central Asian peoples (except Turkomans), even with the highly mongolized Kirghiz, forced Ginzburg to join Oshanin and IArkho in their opinion that in Central Asia absolute measurements of the head permit a better differentiation of racial types than the cephalic indices.

Height-length index ($M=69.77$) agrees with the other characterizations of the extremely high head of Mountain Tajiks. Orthocephalics are few; chamaecephalics are practically absent.

Occipital deformation was found in 69 percent of cases, in Darvaz more frequently than in Karategin. This deformation was usually asymmetrical.²⁸ Asymmetrical deformity is usually due to the influence of the position of the infant's head in the cradle.

²⁷ Following Bunak's method.

²⁸ Ginzburg differentiated the naturally flat occiput from the deformed "flattened" occiput.

According to Oshanin, Bukharan Tajiks had a flattened occiput in 20 percent of the cases; deformed occiput in 70 percent of the cases. A flat occiput is more common among Jews. In the case of Uzbeks, percentages vary. Among Uzbeks ("Sarts") from Tashkent, Shishlov found 70.3 percent of deformed occiputs; 41.2 percent of cranial asymmetry. Among Vanch Tajiks Korovnikov found 34.7 percent occipital deformation.

Within the range of probable error, the correlation between breadth and length in the entire material (without taking into consideration the degree of occipital deformation) is so little as to be practically absent. The correlation calculated for certain groups having varying degrees of deformation shows that the correlation is positive where deformation is absent, the correlation is lessened where deformation is slight, and negative where deformation is strong. The validity of this observation is proved by the fact that the coefficient of correlation greatly exceeds its probable error.

Stature.—Mountain Tajiks are of medium stature ($M=165.83$), with a preponderance of medium-tall and tall individuals.

Considerably lower stature is found in central and eastern Darvaz. The lowest stature has been observed in Vakhio (eastern portion of Tavil Darya region) and in the Kalai Khumb region (Piandzh coastal region).

A comparison of stature disclosed that the Ferghana and Plains Tajiks have in general greater stature than the Mountain Tajiks. The stature increases in the western Pamirs, except for Tajiks and Jews measured in Bukhara by Oshanin.

The stature of other people of Central Asia varies greatly, so that this measurement is of little value for general diagnostic characterization of the group.

The population of central Darvaz, because of their lower stature, have a smaller trunk length and a correspondingly larger relative sitting-height index. This is also true of the population along Piandzh and in the Tavil Darya region.

Bukharan and Pskem Valley Tajiks do not differ from Mountain Tajiks in their relative sitting-height index. Vanch Tajiks differ in this respect (probably because of the technique used by Korovnikov). Jews from Bukhara and Kernini have the same index as Mountain Tajiks, and slightly lower than Bukharan Tajiks.

Uzbeks of Shakh-rasiab and Khwarazm have a higher, those of Tashkent a much lower, relative sitting-height index. While the variations of this index among the Uzbeks parallel those of Tajiks, in general the former are slightly more brachyskelic.

TABLE 17.—*Head size and cephalic index under varying degrees of occipital deformation*
(24-50 years old)

Region	Adjusted for deformation															
	No deformation			Slight deformation			Medium and strong deformation			Unadjusted for deformation						
	No.	L.	B.	C. I.	No.	L.	B.	C. I.	No.	L.	B.	C. I.				
Karategin	99	185.40	152.34	82.0	56	183.11	156.11	85.3	19	180.22	156.21	86.7	174	184.10	153.90	83.5
Central and eastern Darvaz ..	17	186.17	150.92	80.7	93	183.59	151.49	82.5	22	183.40	156.12	85.3	150	183.70	152.0	83.5
Southwestern Darvaz	28	183.44	151.55	82.7	97	181.42	150.71	83.0	33	177.74	155.07	87.2	184	180.00	151.60	84.0
Totals	144	185.05	153.03	82.7	246	182.62	152.22	83.3	74	179.98	155.66	86.5	508	182.80	152.55	83.5

TABLE 18.—*Correlation between head length and head breadth*
(24-50 years old)

Region	Adjusted for deformation						
	Undeformed		Slightly deformed		Medium and strong deformation		
	No.	R.	No.	R.	No.	R.	
Karategin	99	0.134	0.083	56	0.083	19	- 0.073
Central and eastern Darvaz ..	17	0.126	0.22	93	0.052	22	- 0.102
Southwestern Darvaz	28	0.279	0.04	97	0.059	33	- 0.318
Totals	144	0.125	0.013	246	0.0875	74	- 0.102

Unadjusted for deformation		
No.	R.	Mr
174	+ 0.032	0.075
150	+ 0.054	0.081
184	- 0.097	0.073
508	- 0.0208	0.044

TABLE 19.—*Head height*

TURKESTAN			
People	No.	Mean	Author
Bukhara	163	128.0	Oshanin
Pskem Valley ¹	100	127.07	
Ferghana	200	132.35	I Arkho
Teke	51	129.0	I Avorskii
Chaudyrs	200	129.13	I Arkho
Iomuds	107	132.33	I Arkho
Arabs	20	155.0	Maslovskii
Arabs	17	155.0	Maslovskii
AFGHANISTAN			
Afghans	18	153.0	Matseevskii

¹ And Mountainous Bukhara.

TABLE 20.—*Height-length index*

TURKESTAN			
People	No.	Mean	Author
Bukhara	163	70.82	Oshanin
Pskem Valley ¹	100	71.33	
Ferghana	200	71.47	I Arkho
Chaudyrs	200	66.88	I Arkho
Iomuds	107	68.40	I Arkho
AFGHANISTAN			
Afghans	18	74.43	Matseevskii

¹ And Mountainous Bukhara.

TABLE 21.—*Physiognomic height*

TURKESTAN			
People	No.	Mean	Author
Ferghana	200	186.92	I Arkho
Teke	51	186.0	I Avorskii
Chaudyrs	200	184.87	I Arkho
Iomuds	107	184.28	I Arkho
IRAN			
Iranians	50	191.0	Maslovskii
AFGHANISTAN			
Afghans	18	198.0	Matseevskii
Afghans	18	190.0	Poiarkov

¹ And Mountainous Bukhara.

The Kirghiz are the most brachyskelic people of Central Asia according to all available literature, and invariably possess higher relative sitting-height indexes.

Average data for stature and cephalic-index correlations was tabulated for other Central Asian groups, and an apparently reverse phenomenon was observed—i.e., greater stature was accompanied by lesser cephalic index. In order to investigate this contradiction, a small group of brachycephalic peoples was taken (Kirghiz, Uzbek, Kara-Kalpak, Jews, and Arabs of Central Asia), and the coefficient of correlation was calculated for the group. This was insignificant but negative ($R = -0.076 \pm 0.199$), and typical for intertribal correlation of stature and cephalic index pointed out by Pearson.

The positive correlation among the Tajiks seemed to indicate the intratribal character of the difference, which would seem to strengthen

TABLE 22.—*Correlation between stature and cephalic index of Tajiks aged 24 to 50*

Region	Deformed occiput			Undeformed occiput		
	N.	R.	M_r	N.	R.	M_r
Karategin	74	+ 0.0203	0.068	28	- 0.141	0.081
Central and eastern Darvaz.	111	+ 0.006	0.095	18	- 0.32	0.215
Southwestern Darvaz	129	+ 0.081	0.031	27	- 0.031	0.19
Totals	314	+ 0.094	0.006	143	- 0.120	0.071

Ginzburg's premise that the Tajiks belong to a single group, fairly homogeneous in character.

An attempt was made to verify this conclusion by calculating the individual correlation data for the entire group and for the regions.

Cranial deformation was found to be a significant factor. In the presence of occipital deformation the correlation was found to be insignificant but invariably positive.

In the presence of undeformed occipita the correlation is negative, and the coefficient of correlation is fairly sizable. Thus, it is clearly seen that the cephalic index decreases with the increase of stature, but that occipital deformation entirely obscures these relationships.

In comparing cephalic index with stature it may be seen that the decrease of cephalic index progresses until tall medium stature is reached, but that in the presence of high (170.0 cm.) stature cephalic index increases both in the case of deformed and undeformed occipita.

The problem of interdependence of cephalic index and stature is an independently important problem of ontogenetic development, of particular interest in connection with the study of deformed occipita.

Facial dimensions and indices.—Morphological face height (nasion-gnathion) ($M = 126.92$) is great, but in comparison with the facial

height of other Central Asian peoples is medium. High faces predominate. In Karategin face height ($M=129.34$) is greater than in Darvaz ($M=125.67, 125.35$). The comparison of data with the results obtained by various authorities is difficult and sometimes impossible because of techniques employed. Oshanin and IArkho accepted as nasion the lower end of the eyebrows. Korovnikov measured from the deepest point of the bridge as did Tsimmerman and Stein.

According to Stein (Joyce) Darvaz facial height is also less than in Karategin. In Vanch his measurements agreed with those of Korovnikov, disclosing a greater height than in Darvaz and comparable to facial height in Karategin. Ginzburg and others found, however, that facial height in Vanch is less than that of Karategin.

It is still more difficult to compare the facial height of Tajiks with that of other peoples. Uzbeks and Jews have varying facial height, sometimes greater and sometimes less than that of Tajiks. The same phenomenon prevails among Turkomans, the Iomuds equaling that of the Tajiks, the Chaudyrs being greater. Arabs and Kirghiz have greater facial height than Tajiks.

Morphological face height, while valuable for characterizations of various groups within a people, is, in many cases, not indicative of differences between various peoples.

Physiognomic face height ($M=182.52$) is medium, with a preponderance of greater sizes. In general, it varies by regions comparably to the morphological face heights. It is easier to compare face height with the figures disclosed by various authors. IArkho's Ferghana Tajiks have somewhat greater face height than Mountain Tajiks. Kirghiz have greater face height; Uzbeks vary, giving smaller and greater values, although the latter prevail. The Turkomans range between that of Ferghana and Mountain Tajiks.

The bizygomatic breadth ($M=140.66$) is medium, compared to the European facial breadth, but rather low for Central Asia. The distribution of broader and narrower faces is regular. In Karategin facial height is greater than in Darvaz. Facial breadth in southwestern Darvaz is somewhat less than in central Darvaz. The methods of measurements vary greatly. Karategin Tajiks approach IArkho's and Maslov's Ferghana and Plains Tajiks. Pskem Valley and Bukharan Tajiks have narrower faces and are comparable to central Darvaz Tajiks. Korovnikov's data from Vanch cannot be utilized for comparative purposes because of difference of method used. Joyce's data show greater figures for Karategin than for Darvaz.

Kirghiz have greater facial breadth than Tajiks. Uzbeks and Turko-

mans vary comparably to Tajiks in Karategin and Darvaz respectively. Arab facial breadth approaches that of Karategin Tajiks. Smallest bizygomatic breadth is found in the Jews who are comparable to southwestern Darvaz Tajiks.

Frontal height ($M=55.5$) is medium, but varies by regions. The greatest is found in southwestern Darvaz ($M=56.21$); Karategin ($M=55.04$) has the intermediate place, while lowest frontal height is found in central and eastern Darvaz ($M=53.06$).

Minimum frontal diameter ($M=107.51$) is of average size for Central Asia, and does not vary greatly in different regions, being greater in Karategin and lesser in southwestern Darvaz than in central and eastern Darvaz.

Frontal-zygomatic index varies to a greater degree because of greater intensity of the decrease of zygomatic diameter in various regions.

Tajiks from Ferghana, Turkomans, and Chaudyrs have a similar index; Kirghiz and Uzbeks, somewhat greater; Iomuds, much smaller.

Bigonial breadth is small and varies: Karategin 108.23; central and eastern Darvaz 107.89; and southwestern Darvaz 106.36. Ferghana Tajiks and Kirghiz have greater breadth, Uzbeks and Turkomans the same or greater.

Morphological face index ($M=90.17$) is leptoprosopic. There are more hyperleptoprosopic individuals than mesoprosopic. Euryprosopics were very rare and hypereuryprosopic individuals were practically absent. Morphological face index does not vary by region, greatest deviation being in Vanch region, with a lower index prevailing as a result of generally lower morphological height.

Because of variation of method, it is impossible to compare the morphological face index of the Mountain Tajiks with most of the other peoples measured. Ferghana (IArkho), Pendzhikent (Vishnevskii), and Bukhara (Oshanin) Tajiks have a similar index as do the Kirghiz, Uzbeks, and Jews; Turkomans have a slightly higher index.

Physiognomic face index ($M=77.55$) is of medium size, with preponderance of lower values. The variations are not great and, in general, correspond to those of the morphological face index.

The physiognomic face index of southwestern Darvaz and Surkh Oba Valley Tajiks is similar to that of Ferghana Tajiks. The index of Kirghiz, Uzbeks, and Turkomans varies within the same range as that of Mountain Tajiks.

Thus it may be stated that in Central Asia facial indices are better suited for the characterization of subdivisions within a group than

for comparison of larger groups ("intro-group" rather than "inter-group").

Vertical face profile.—Straight in the majority of cases (85.62 percent); slightly prominent in 13.7 percent of cases; prognathism rare (1.31 percent), usually among Karategins.

Straight profile most prevalent in southwestern Darvaz (97.48 percent). Because of discrepancy of methods the data cannot be compared with those of other recorders; yet it appears from Oshanin's figure that the profile of both Uzbeks and Jews is more prominent than that of Mountain Tajiks.

General form of face is ovoid in 40.08 percent. Breadth of mouth medium. Lip thickness medium, 47.27 percent, and thick, 34.42 percent. Chin prominent, 89.76 percent.

TABLE 23.—*Position of eyeball*

Group	Locality	Deepest Percent	Medium Percent	Protuberant Percent	Author
Tajiks	.....Darvaz II	40.26	58.49	1.26	Ginzburg
Tajiks	.....Bukhara	5.0	62.0	33.0	Oshanin
Uzbeks	.....Shakhrasiab	4.9	85.0	10.2	Oshanin
Jews	.....Bukhara	8.0	65.0	27.0	Oshanin
Jews	.....Shakhrasiab	7.8	70.4	12.8	Oshanin

Thus the face of Mountain Tajiks may be characterized as narrow, of medium height, with medium or weakly expressed cheek bones, medium or strong cross section, and straight vertical profile.

In general, Karategin Tajiks have greater absolute dimensions of face than the Tajiks of Darvaz.

External eye.—Eye opening spindle-shaped in 98.70 percent; rare cases of almond-shaped eyes are mostly from Karategin and are more common among Bukharan Tajiks and still more common among Bukharan Jews (Oshanin). However, he remarks that this does not present valid enough difference between Tajiks, Uzbeks, and Jews. The majority of Kirghiz have almond-shaped eyes. Vanch Tajiks (Korovnikov) cannot be compared with the present series because of variations in methods of measurement. Eye width (distance between inner and outer corners) was medium in 48.27 percent. Narrow eyes are more common in Karategin; wide eyes in southwestern Darvaz.

Eyes deep-set, 40.26 percent; medium (southwestern Darvaz only), 58.49 percent. Protuberant eyeballs observed only in Shuroabad and Muminabad regions (1.26 percent).

Mongoloid fold of upper eyelid found only in 3.68 percent, and is

usually not strongly expressed. Ginzburg did not record one fully developed Mongoloid fold among adults (24 to 50). Mongoloid fold was most frequent in Karategin (Surkh Oba Valley), and most rare in central and eastern Darvaz.

Mongoloid fold is much more common among nonadult individuals. In a young group (18 to 23) it was absent in 78.34 percent, weakly developed in 19.11 percent, strongly expressed and medium in 1.27 percent of cases. In this age group, Mongoloid fold was most commonly present in southwestern Darvaz.

Mongoloid fold is as rarely observed among Bukharan Tajiks (Oshanin), Pendzhikent Tajiks (Vishnevskii), and Ferghana Tajiks (IArkho). Tsimmerman observed a Mongoloid fold more frequently in Pskem Valley. However, the ages were not differentiated in comparative data.

Mongoloid fold is rarely observed among the Jews; among Turko-mans (IArkho) percentages vary in groups, and the same is true of Uzbeks although here it is more clearly expressed than among Tajiks. The same is true of Kirghiz with the exception of the Issyk-Kul group, where it was found in the majority of cases. This variation may be due to difference of recording method.

In contrast to the Mongoloid fold the upper eye fold among Mountain Tajiks was absent in 36.15 percent. It was weakly developed in 25.97 percent, medium in 25.32 percent, and strong in 12.56 percent of all individuals.

The upper fold is more common in Darvaz than in Karategin; in southwestern Darvaz it is better expressed than in central and eastern Darvaz. Comparative study of upper fold discloses that it is somewhat better expressed among Pendzhikent Tajiks (Vishnevskii) to a degree similar to that observable in southwestern Darvaz. Various degrees of development of upper fold are found among Uzbeks and Jews. In general, Jews have less-developed upper fold than the Tajiks, and much less-developed than the Uzbeks.

Thus, it may be concluded that the Mongoloid traits in the structure of the eye are but slightly expressed among the Mountain Tajiks, but that Mongoloid influence is undoubtedly felt. This may be seen through the study of the younger individuals, and also from the relatively high percentage of strongly and less strongly expressed fold of the upper lid. This influence is most strongly felt in southwestern Darvaz, then in Karategin, and, least of all, in central and eastern Darvaz.

Nose structure.—The nose is usually of medium size (54.33 percent). Large noses appear in 39.18 percent, small in 6.49 percent.

TABLE 24.—Comparative table on upper eyelid

People	Locality	Mongol fold Percent	Upper fold Percent	Author
Tajiks	Bukhara	5.2	...	Oshanin
Tajiks	Pskem Valley	11.0	...	Tsimmerman
Tajiks	Pendzhikent	4.3	89.6	Vishnevskii
Tajiks	Ferghana	5.0	...	IArkho
Tajiks	Karategin	5.26	55.55	Ginzburg
Tajiks	C. and E. Darvaz	2.26	58.33	Ginzburg
Tajiks	S. W. Darvaz	3.14	77.36	Ginzburg
Uzbeks	Khwarazm	25.0	...	Oshanin
Uzbeks	Shakhrasiab	10.1	72.4	Oshanin
Uzbeks	Karshi	22.5	...	Oshanin
Uzbeks	Samarkand	24.2	98.1	Vishnevskii
Uzbeks	Ferghana	7.1	...	IArkho
Uzbeks	Angren	7.5	...	IArkho
Uzbek Kipchaks	Ferghana	23.0	...	IArkho
Uzbek Maugyt	Ferghana	35.4	...	IArkho
Jews	Bukhara	0.0	...	Oshanin
Jews	Shakhrasiab	1.0	21.6	Oshanin
Jews	Samarkand	0.0	87.3	Vishnevskii
Turkomans (Chaudyrs)...		24.6	80.3	IArkho
Turkomans (Iomuds)...		6.6	67.0	IArkho
Kirghiz	Issyk-Kul	86.0	...	Oshanin
Kirghiz	Tien Shan	24.0	95.0	IArkho
Kirghiz	Ferghana	19.4	...	IArkho

TABLE 25.—Comparative table of development of upper eye fold

People	Locality	No.	None Percent	Light Percent	Medium Percent	Strong Percent	Author
Tajiks	Karategin	171	44.45	20.46	25.73	9.36	Ginzburg
Tajiks	Darvaz I	132	41.67	35.60	16.67	6.06	Ginzburg
Tajiks	Darvaz II	159	22.64	23.90	32.08	21.39	Ginzburg
Tajiks	Pendzhikent	279	10.4	25.0	43.9	19.8	Vishnevskii
Uzbeks (tribesmen)		...	1.9	10.2	65.0	22.9	Vishnevskii
Uzbeks	Shakhrasiab	100	27.5	44.0	25.5	2.0	Oshanin
Jews	Samarkand	143	12.7	31.4	50.8	5.1	Vishnevskii
Jews	Shakhrasiab	101	78.4	17.0	4.6	...	Oshanin
Kirghiz	Tien Shan and Ferghana	...	5.0	...	...	...	IArkho

Straight profile is most common (40.47 percent). Wavy nose, 24.03 percent; convex, 17.75 percent; concave, 11.47 percent; "with a break," 6.28 percent. For convenience, these forms have been grouped in three classes:

1. Concave, 11.47 percent.
2. Straight (straight and "wavy" concavo-convex), 64.50 percent.
3. Convex (convex and "with break"), 25.03 percent.

Concave noses are more common in Darvaz, especially in the central and eastern portions, than in Karategin, while convex ones are more common in Karategin. Concave noses are least common among Bukharan Tajiks. Pendzhikent Tajiks do not differ from the Mountain Tajiks from Darvaz. Korovnikov's Vanch Tajiks have an unusually large percentage of concave noses (32.5 percent). It is probable that his figures are affected by age range represented.

Comparison with other data discloses that Uzbeks have nearly the same distribution of variations. Jews and Arabs have fewer concave and more convex forms. The Kirghiz of Issyk-Kul have a much greater percent of concave forms, which cannot be said of Tien Shan Kirghiz.

The profile of the bony and the cartilaginous structure of the nose was observed only in southwestern Darvaz. No significant difference was observed between this character of Tajiks and of other peoples of Central Asia (IArkho's data), so that it was found difficult to utilize them for racial criteria.

General protuberance of the nasal ridge was observed only in Darvaz. Medium protuberance was observed in the majority of cases. Strong protuberance was next numerous; least numerous were the cases of slight protuberance. In central and eastern Darvaz very prominent noses were more common than in southwestern Darvaz, with the exception of the Muminabad region.

In Central Asia this is a very typical trait, differentiating the Mongolized Kirghiz and some other Mongolized tribes much better than the profile of the bony and cartilaginous structure.

According to Oshanin the Jews have even more prominent nose ridges than the Tajiks.

The bridge height of Tajiks was usually medium (55.41 percent) less commonly great (42.21 percent). Low nose bridge was observed only in 2.38 percent.

Small nasal bridges were much fewer in central and eastern Darvaz than in all other regions. There were exceptionally few individuals with high nasal bridges in Vanch.

Mountain Tajiks have the highest nasal bridge in Central Asia

with the exception of the Jews, who have a still higher percentage. Bukharan Tajiks, like Mountain Tajiks, have high nasal bridges. Ferghana Tajiks approach the Uzbeks. Kirghiz, Kara-Kalpaks, Mangyt Uzbeks, and Chaudyr Turkomans have greater percentages of individuals with low nasal bridges and smaller percentages of

TABLE 26.—Comparative table of nasal profile

People	Locality	Concave Percent	Straight or concavo- convex Percent	Convex or aquiline Percent	Author
Tajiks	Pendzhikent	17.7	63.3	23.1	Vishnevskii
Tajiks	Bukhara	5.0	51.0	44.0	Oshanin
Tajiks	Pskem Valley	12.0	42.0	46.0	Tsimmerman
Tajiks	Vanch	32.5	52.5	15.0	Korovnikov
Tajiks	Ferghana	...	...	19.6	IArkho
Uzbeks	Khwarazm	16.0	58.0	26.0	Oshanin
Uzbeks	Shakhrasiab	13.2	67.3	19.5	Oshanin
Uzbeks	Karshi	22.5	57.5	20.0	Oshanin
Uzbeks (clansmen)	...	20.4	72.9	6.08	Vishnevskii
Uzbeks (clansmen)	Ferghana	7.3	64.9	28.8	IArkho
Uzbeks (clansmen)	Angren	...	...	28.1	IArkho
Uzbeks Kipchaks	...	9.1	62.6	28.3	IArkho
Uzbeks Mangyts	...	2.5	95.0	2.5	IArkho
Jews	Bukhara	5.0	27.0	68.0	Oshanin
Jews	Shakhrasiab	2.9	32.0	65.0	Oshanin
Jews	Samarkand	7.0	51.2	41.7	Vishnevskii
Arabs	Karshi	3.0	48.0	49.0	Oshanin
Turkomans Chaudyrs	Khwarazm	8.6	70.7	20.7	IArkho
Turkomans Iomuds	Khwarazm	2.8	71.1	27.1	IArkho
Kirghiz	Issyk-Kul	48.0	52.0	...	Oshanin
Kirghiz	Tien Shan	12.2	67.6	20.2	IArkho
Kirghiz	Ferghana	13.0	64.3	22.7	IArkho
Kara-Kalpaks	Kara-Kalpak A.S.S.R.	5.0	82.3	12.7	IArkho
Kara-Kalpaks	Ferghana	10.1	69.7	20.2	IArkho

individuals with higher nasal bridges. This observation is also valid for differentiating the anthropological types of Central Asia. Breadth of nasal bridge is usually medium (51.51 percent); small breadth is found in 34.85 percent, and great in 13.64 percent of cases. Broad-bridged individuals were more common in Karategin than in Darvaz.

Comparing the Tajik's nasal bridge with that of other peoples, we see that they stand in this respect nearest to Jews. Among Uzbeks and Arabs there are few individuals with narrow bridges.

TABLE 27.—*Comparative table of nasal bridge height*

People	Locality	No.	Low Percent	Medium Percent	High Percent	Author
Tajiks	Bukhara	100	3.0	68.0	29.0	Oshanin
Tajiks	Ferghana	199	13.1	70.8	16.1	Iarkho
Tajiks	Karategin	171	2.34	50.87	46.78	Ginzburg
Tajiks	Darvaz I	132	2.27	68.94	28.79	Ginzburg
Tajiks	Darvaz II	159	2.52	49.06	48.43	Ginzburg
Uzbeks	Shakhrasiab	190	7.9	84.2	7.9	Oshanin
Uzbeks	Karshi	198	14.1	79.3	6.6	Oshanin
Uzbeks	Mangyts	78	46.1	51.3	2.6	Iarkho
Uzbeks	Khiva	100	10.0	80.0	10.0	Iarkho
Uzbeks	(not clans) Ferghana	386	10.1	68.4	21.5	Iarkho
Uzbeks	Kipchaks	99	21.2	68.7	10.1	Iarkho
Uzbeks	Angren	82	15.9	70.7	13.4	Iarkho
Uzbeks	Khwarazm	100	7.0	64.0	29.0	Oshanin
Kara-Kalpaks	Kara-Kalpak					
	A.S.S.R.	299	43.2	56.5	0.3	Iarkho
Kara-Kalpaks	Ferghana	99	28.3	64.7	7.1	Iarkho
Turkomans	Chaudyrs	198	28.3	66.2	5.5	Iarkho
Turkomans	Iomuds	107	7.5	68.2	24.3	Iarkho
Kirghiz	Issyk-Kul	100	67.0	27.0	6.0	Oshanin
Kirghiz	Tien Shan	769	30.0	65.6	4.4	Iarkho
Kirghiz	Ferghana	154	26.6	68.8	4.6	Iarkho
Jews	Bukhara	100	2.0	36.0	62.0	Oshanin
Jews	Shakhrasiab	103	1.0	25.2	73.8	Oshanin
Arabs	Karshi	100	2.0	68.0	30.0	Oshanin

TABLE 28.—*Comparative table of nasal bridge breadth*

People	Locality	Narrow Percent	Medium Percent	Broad Percent	Author
Tajiks	Karategin	35.67	46.78	17.54	Ginzburg
Tajiks	Darvaz I	31.82	53.79	14.4	Ginzburg
Tajiks	Darvaz II	36.48	54.71	8.81	Ginzburg
Tajiks	Bukhara	26.0	66.0	8.0	Oshanin
Uzbeks	Khwarazm	19.0	61.0	20.0	Oshanin
Uzbeks	Shakhrasiab	4.7	88.4	6.9	Oshanin
Uzbeks	Karshi	4.5	83.0	12.5	Oshanin
Jews	Shakhrasiab	33.7	66.3	...	Oshanin
Jews	Bukhara	34.0	58.0	7.0	Oshanin
Arabs	Karshi	6.0	75.0	19.0	Oshanin

The nasal tip is most commonly rounded (55.85 percent); a sharp nose is found in 35.72 percent of cases. Angular tip was found in 6.53 percent, blunt tip in 2.82 percent. Rounded tip was slightly less common in Darvaz than in Karategin. Sharp tip was most common in southwestern Darvaz. Angular and blunt forms were found most commonly in central and eastern Darvaz. With regard to the form of the tip, the Mountain Tajiks stand midway between the Jews (among whom a sharp form is more common) and Uzbeks (among whom sharp form is rarer, but rounded and blunt forms are more common, according to Oshanin).

The inclination of the nasal tip is more commonly horizontal (51.51 percent) or pointing downward (42.21 percent). The deviations from the horizontal are usually slight. There is no great difference between regional degrees of nasal inclination. A slightly higher percentage of raised tips is found only in the Kalai Khumb region along the Piandzh River and in Vanch. From a comparison of our data with those obtained by IArkho and Oshanin, it was observed that Mountain Tajiks differ in this respect from the other groups of Central Asia, having the highest nasal index (i.e., having the smallest percentage of raised noses). Shakhrafiab Jews are nearest to them in this respect. Ferghana Tajiks and Angren Uzbeks are the next nearest. Tien Shan and Kuram Kirghiz are slightly more snub-nosed.

The inclination of the base of the nose was examined only in southwestern Darvaz; a relatively large percentage of individuals with upward trend was found in Shuroabad region, and a relatively small percentage of such individuals occurred in the Muminabad region.

According to IArkho's figures only Angren Uzbeks are comparable to Shuroabad Tajiks in this regard. All other groups, including Ferghana Tajiks, give a much lower percentage. Jews (Oshanin) also give a slightly larger percentage of raised, and lower percentage of lowered, noses. Bukharan Tajiks give a slightly lesser percentage of lowered forms.

The height of nasal wings is most often medium (42.42 percent) or small (40.02 percent). Great height was observed only in 17.53 percent. A greater percentage of high nasal wings was observed in Darvaz and lower in Karategin. Particularly great wing height was observed in Vanch. Smallest wing height was observed in Karategin and southwestern Darvaz. In comparison with IArkho's figure, measurements in Darvaz were very low. Only in Darvaz is wing height comparable to that of other Central Asian groups. Great wing height is commonest among Mangyt Uzbeks and Ferghana Karalpaks.

Ferghana Tajiks in this respect approach the Tajiks of southwestern Darvaz. Bukharan Tajiks (Oshanin) have an exceedingly low percentage of low wings, and heavy preponderance of medium. High wings predominate among the Jews.

The flare of alae is usually small (58.02 percent) or low (38.09 percent). Strong flaring was observed in 3.89 percent. The degree of flaring was found higher in Karategin than in Darvaz.

The percentage of highly flaring wings among Bukharan Tajiks was like that in Karategin. The Jews approached the percentage observed in Darvaz. Uzbeks have a much greater percentage of greatly flaring wings, while the Arabs stand in the middle (Oshanin).

The nasal furrows were usually medium (47.40 percent) or slight (35.93 percent). Highly developed furrows were found in 16.67 percent. More highly expressed furrows were found in Karategin, less so in Darvaz. In this respect, the Tajiks of Bukhara and Ferghana approach Mountain Tajiks. Tien Shan Kirghiz and Khiva Uzbeks are nearer the Karategin Tajiks. Shakhresiab Jews have much less pronounced furrows, while Bukharan Jews approach Bukharan Tajiks. Uzbeks generally have much less developed furrows than Tajiks.

The size of nostrils is: Small 15.40 percent; medium, 56.28 percent; and large, 29.23 percent. Small nostrils are more common in Karategin than in Darvaz. The largest nostrils are found among the Jews and the Arabs; Tajiks and Uzbeks are next. The Kirghiz have a predominance of small nostrils.

Form of nostrils.—Oval, 92.64 percent; round, 5.84 percent; and triangular, 1.52 percent. Higher percentage of oval nostrils in Darvaz than in Karategin.

The percentage of oval nostrils is higher among the Jews, and similar to that of Arabs. Among the Uzbeks the rounded form is slightly more common. The Kirghiz have a slightly greater percentage of round nostrils than the other groups.

The direction of maximal diameter of nostrils was diagonal, 53.25 percent; sagittal, 42.21 percent; crosswise, 4.55 percent. Sagittal direction is slightly less common in Darvaz than in Karategin. It is slightly more common among the Jews. Uzbeks are like Tajiks, having smaller percentages of sagittal diameters. Sagittal direction is still less common among Kirghiz.

Nasal length (nasion-subnasale) is large ($M=58.14$). Shorter noses are more common in southwestern Darvaz (except in Mumina-bad and Tavail Darya regions where the maximum length is observed). Jews and Uzbeks have comparable nose length, the latter with a

slightly greater percentage of long noses. Nasal length of Kirghiz varies by regions, being greater than that of Tajiks in Tien Shan; equal, in Ferghana; less, in Issyk-Kul and Pamirs.

Nasal breadth ($M = 34.40$) is medium to small. It is slightly greater in Karategin, smaller in southwestern Darvaz than in central and eastern Darvaz. As an exception, widest nostrils have been observed in Vaneh.

Among the Jews, nasal breadth is generally less than in Karategin and eastern and central Darvaz; it approaches that of southwestern Darvaz. Uzbeks have similar, or greater, nasal breadth, Turkomans have greater; the greatest nasal breadth has been observed among the Kirghiz.

Nasal index is fairly low ($M = 59.44$). Tajiks are mostly leptorrhine (65.80 percent); hyperleptorrhines are 25.97 percent; mesorrhines, 8.01 percent.

The highest nasal indices were found in extreme southwestern Darvaz, although in general little variation was found between Karategin and Darvaz.

Owing to differences of method, it has not been possible to compare the data with those obtained by other investigators. However, it is possible to state that the Kirghiz have the highest, and Jews the lowest, nasal indices.

Ear measurements ($L = 61.07$, $B = 33.20$, $\text{Index} = 65.51$). Form: oval, 60.09 percent; elliptical, 15.42 percent; pear-shaped, 13.60 percent; triangular and heart-shaped, 7.94 percent. Ear lobe, medium; adhering lobe more common in southwestern Darvaz.

PEOPLES OF UZBEKISTAN

Oshanin²⁹ observed that in 1923 a large portion of the population of Khwarazm called themselves "Sarts" and considered themselves distinct from the Uzbeks. Originally this term signified traders or merchants. At the present time both groups, the Uzbeks and the "Sarts," are called Uzbeks.³⁰ While no attempt has been made in this study to describe the differences of physical type between the Khwarazmian "Uzbeks" and the Tashkent "Sarts," Oshanin states that the modern settled Khwarazmians, known as "Uzbeks," do not differ

²⁹ Oshanin, L. V., *Tysiadietniiia davnost dolichotsefalii u turkmen i vosnoi-zhnye puti ee proiskhozhdeniia*. *Izvestia, SREDAZKOMSTARIS*, No. 1, pp. 131-132, 1926.

³⁰ The most recent invaders of this area were the Turko-Mongol conquerors during the sixteenth century.

from the denizens of Tashkent who were formerly known as "Sarts" and are now called "Uzbeks."

The data on 119 Sarts used by Oshanin had been collected and published by A. P. Shishlov. Both the Khiva Uzbeks and the "Uzbeks" of Tashkent are in equal degree representatives of the ancient Indo-European³¹ type, i.e., of the Iranian physical type which once inhabited the entire area of Turkestan, and was but slightly Mongolized by subsequent stratifications, in the course of centuries, of the Turko-Mongolian tribes. The Uzbeks of Khiva have a somewhat greater admixture of this Mongolian element, yet among them the traits of the Indo-European type are much more clearly expressed.

Accordingly, both terms "Sart" and "Uzbek" will be used in this work to denote the Iranian populations of Turkestan in general and Khwarazm in particular, who had become completely Turkized as to the language, but have remained until this day but very slightly Mongolized as to racial type.

During the study of historical sources Oshanin came across an item of information of anthropological character, from the tenth century A. D., which drew attention to the Turkomans.

The entire factual information regarding the Turkomans used in this work is that of IAvorskii based on a very small series of only 59 males. Consequently, the theories herein proposed are presented as a provisional working hypothesis subject to change on the basis of additional data. This hypothesis is based entirely on the cephalic index.³² The extreme dolichocephaly of the Turkomans stands out amid the brachycephaly of all other peoples of Turkestan. The remaining Indo-European traits of the Turkomans (stature, nasal index, pigmentation) are given at the end of this article on the basis of IAvorskii's data.

K. L. Inostrantsev, in his work on the pre-Muslim culture of the Khiva Oasis, quotes Al-Mukkadisi to the effect that the settled Khwarazmians, whose Indo-European nature has been universally accepted in the interior of the irrigated Khiva Oasis, had become so similar to the Turks, who were wandering on the periphery of the oasis, that when Khwarazmians happened to go to one of the neighboring Muslim countries (Mawerannahr,³³ Persia, or Arabia) they were mistaken for Turks, and as such sold into slavery.

³¹ In the sense of *Homo sapiens indo-europaeus* of Giuffrida-Ruggieri.

³² Boas and Fleming notwithstanding, but with the support of Pearson and Dixon. (L. V. O.)

³³ By this name the Arabs understood the area between Oxus and Jaxartes, with the exception of the Khiva Oasis.

From an anthropological point of view this fact of the similarity between the Aryans and the nomadic Turks is paradoxical. Present-day settled Khwarazmians, both "Sarts" and "Uzbeks," are undoubtedly less similar to the nomadic Turkish peoples than one could conclude from the words of Al-Mukkadisi. This is easy to understand since during the four centuries following Sheibani's conquests the Uzbeks, who were (originally) a motley conglomeration of Turkish tribes and clans subject to the Golden Horde, wandering in the Dasht-i-Kipchak (to the west and north of the Aral Sea), having absorbed the fragments of tribes which were wandering in Mawerannahr, managed to become settled, to become mixed with the ancient Indo-European population of Turkestan, and to lose all degree of purity of their Mongol traits.

Consequently, the modern population of Khwarazm, whether "Uzbek" or "Sart," does not differ in the main from the other populations of Turkestan which are predominantly Indo-European with a small admixture of the "Asiatic,"³⁴ Mongoloid element. However, it would be natural that during a millennium the degree of Mongolization of the native Indo-European types should increase³⁵ rather than decrease.

According to Al-Mukkadisi the measures taken by the Khwarazmian government in order to change the outward appearance of its subjects, and to make them look less like the nomadic Turks, were, according to Inostrantsev (p. 304): "Khwarazmian women were ordered to tie bags filled with sand on both sides of the heads of newborn babies, in order to make their heads wider." In another place Al-Mukkadisi³⁶ states that the Khwarazmians tried to cause the heads of the newborn to become broader and shorter in order to distinguish them from the surrounding nomad Turks.

Al-Mukkadisi's testimony is corroborated by another authority, Yakut ibn-Abdullah, who wrote, at the beginning of the thirteenth century, that among the Khwarazmians broad heads and foreheads were due to the custom of artificial cranial deformation.³⁷

These data regarding brachycephaly also sound paradoxical. The

³⁴ After Giuffrida-Ruggieri.

³⁵ Mongol tribes were the masters; cf. language, conquest, etc.

³⁶ Oshanin admits that he does not know whether Inostrantsev quotes Al-Mukkadisi verbatim or gives a free rendition of the general sense. (E. P.)

³⁷ Barthold checked the references from Al-Mukkadisi (Arabic text in *Biblioth. Geograph. Araborum*) and found the rendition of the sense "correct." He thought that Yakut ibn-Abdullah's reference may have been copied by Yakut from Al-Mukkadisi.

modern settled population of Khiva Oasis are in this respect very closely related to the "Sarts" with a tendency toward subbrachycephaly. Oshanin states that this brachycephaly is not due to the modern practice of artificial cranial deformation. While occipital flattening, due to the type of cradle, is found among both "Sarts" and "Uzbeks," this type of flattening does not affect the cephalic index to such a high degree. Flattening had been observed equally among dolichocephalic and brachycephalic individuals. Consequently, the brachycephaly of the "Sarts" and "Uzbeks" can be considered to be innate. Al-Mukkadisi also states that dolichocephaly was acquired by Khwarazmians from the surrounding Turkish nomads. Thus, the nomadic Turki tribes of Khwarazm were dolichocephalic. However, we know that the many peoples united by philologists³⁸ under the term "Turki" belong to the Mongol group, whose representatives are distinguished by extreme brachycephaly. Turki nomads of modern Turkestan, the Kara-Kirghiz³⁹ and the Kirghiz-Karakhs⁴⁰ are not exempt from this brachycephaly.

The Turkomans alone are dolichocephalic in predominantly brachycephalic Turkestan.

With which Turki people were the Khwarazmian of the tenth century in closest relation and with which modern ethnic group of Turkestan can they be identified by historians and ethnologists?

N. Veselovskii quotes Arabian travelers and geographers who state that the Khwarazmians were in close contact with nomadic Turki. Arabian authors refer to these nomads as "Guzes."

Yakut writes in his Geographical Dictionary that in the territory adjoining the Turki the contacts between the nomads and the settled peoples were so close that a new language "which was neither Khwarazmian nor Turkish" arose in this area.

Al-Istakhri observed during the thirteenth century: "Khwarazm is a land distinct from Khurasan and Mawerannahr. On all sides it is surrounded by plains; at the same time, to the north and the west its boundaries adjoin the lands [ranges] of the Guzes. The Khwarazmians are in great danger from the Guzes and are perpetually forced to keep them at bay."

Al-Masudi states: "Loaded caravans go at all times from Bulgaria to Khwarazm and back. They always have to defend themselves from the nomadic Turki tribes through whose lands lies their route."

Al-Istakhri, describing the wealth of Khwarazm and the prosperity

³⁸ Cf. Fischer's *Turk Tatarische Stämme*.

³⁹ The Kirghiz proper. (E. P.)

⁴⁰ The Kazakhs. (E. P.)

of its inhabitants, writes: "There are no gold or silver ores here, nor precious stones. The people are rich solely because of the commerce with the Turks . . . the large city of Al-Dzhurdzhania on the southern shore of the Dzheikhun River [the Amu] is the main trading place for the Guzes."

Oshanin does not believe mestization by marriage would take place to any marked degree between settled agricultural people and the nomads. There are no indications that there was mestization with the Turkish troops inside the oases at that early date, although there are definite indications of such mestization at a much later date through captured slaves.

Ethnologists and historians identify the Guzes with the Turkomans for the following reasons:

1. This is indicated by such trustworthy traits as the cephalic index.
2. A thousand years ago Turkomans were as dolichocephalic as they are now.
3. We must conclude that at one time the settled populations of the Khwarazmian Oasis had a much larger admixture of Turkomans than it does now. However, we have no factual data to explain this.

Tentative explanations include the fact that during the eleventh century the Guzes went farther south, to Persia. They started commerce in Persian captives from Khurasan, who were better slaves than the Turkomans and also had farther to go in order to escape. This custom of recruiting Persian slaves continued after the Turkish conquest. During the Russian conquest of Khwarazm in 1873, thousands of Persian slaves were discovered. The descendants of these slaves still live in Khwarazm and are called *kul* (slaves).

There are no indications that Turkomans practice artificial cranial deformation to elongate their heads. The use of the cradle, which was borrowed by the Turkomans from the Sarts, could only flatten the occiput and not elongate the head.

In order to exclude the possibility of "secondary" elements, the Turkomans are compared with their neighbors, the Khurasanians, who during many centuries were subjected to Turkoman invasions. They called them "Alaman"; many became slaves of Turkoman families.

Masalskii states that in the course of only one century, at least one million Khurasanians were enslaved by the Turkomans. IAvorskii adds that until the Russian invasion all the field labor in Turkmenistan was performed by Persian slaves, while Turkomans engaged in nomadic pursuits. Masalskii also explains the purity of the Indo-European traits among the southern (Teke) Turkomans by mestization

with the Persians. Consequently no dolichocephalic influence could have come from Persia, especially since the Turkomans were reported as dolichocephalic during the tenth century and did not come into contact with the Khurasanians until the Seljuk period.

The population of the entire area bounded by Khurasan to the south, the Pamir-Alai and Tien Shan mountain systems to the east, Jetty-Su on the north, and the Caspian Sea and the Aral Sea and the Kirghiz steppes on the west, can be divided into three groups:⁴¹

1. Pure Aryans (*Homo sapiens indo-europaeus* Giuffrida-Ruggieri), Turkestan Tajiks and Khurasanians.

2. Pure Turko-Mongols (*Homo sapiens asiaticus* (Giuffrida-Ruggieri), or E. Fischer's "Mongolian Race"), Kara-Kirghiz and Kirghiz-Kazakh. For lack of data and because of numerical unimportance, such peoples as the Kara-Kalpaks and the Kipchaks have been omitted.

3. Mixed peoples, resulting from mestization of groups 1 and 2, which we shall call "Eurasian type." These include the Sarts and Taranchis of the Jetty-Su region.

For the following four groups some adequate data are available:

1. Turkomans.⁴²
2. Uzbeks of Khwarazm.⁴³
3. Sarts of Tashkent.⁴⁴
4. Kara-Kirghiz⁴⁵ (i.e., Kirghiz) of the southern shores of Issyk-Kul.

For other groups there exist only averages and percentages of brachycephaly, for Turkestan, from S. I. Rudenko's work on the Bashkirs for Iran, and from Deniker and Roland Dixon.

Let us compare the variational series of the cephalic index of the Turkomans, the mixed group (Sarts and Uzbeks), and the Mongol group (Issyk-Kul Kirghiz).

IAvorskii's group included 59 men aged 15 to 60 measured in Merv; 51 were of the Teke tribe, 4 were of the Saryk tribe, 3 Ersari, and 1 Alieli. No data were available for other groups. Oshanin states that both the Iomud tribe (Turkomans in Khiva) and the Turkomans of Murgab appear to be dolichocephalic.

The mixed group is shown to be between the Mongols and the

⁴¹ This is not an attempt to draw a classification for the Turkestan peoples—such an attempt would not be possible on the basis of the available factual data—but is merely a descriptive scheme used for the sake of convenience. (L. V. O.)

⁴² IAvorskii's material.

⁴³ Oshanin's data from 1923.

⁴⁴ A. P. Shishlov's measurements.

⁴⁵ Based on 100 males measured by Oshanin in 1924.

Turkomans, the former being entirely brachycephalic, the latter dolichocephalic.

The Eurasian type, represented by the Uzbeks of Khiva (C.I. 82.21) and the Sarts of Tashkent (C.I. 82.73), resembled the Mongolians (C.I. 84.84), but differed from the Turkomans (C.I. 75.6).

The Turkomans could not derive their dolichocephaly from admixture with the Tajiks, who are also known to be typical brachycephals. They do not differ from northern Persians, whom both Deniker and Dixon class as a dolichocephalic type.

To Oshanin it appears possible that the Kurds are products of mestization of the Assyroid (Central Asian brachycephalic) race with the dolichocephalic Iranian nomadic tribes. Tajik brachycephaly may be linked tentatively to the *Homo sapiens indo-europaeus* var. *brachycephalicus* subvar. *pamircensis* Giuffrida-Ruggieri.

Furthermore, the Persians carried away by the Turkomans to Turkmenistan and Khwarazm from the area adjoining the Turkoman steppes and to the west of Asterabad were the brachycephalic Tajiks. Consequently their importation resulted in the strengthening of the brachycephalic element in Khwarazm.

Because of the isolated position of Turkoman dolichocephaly, the kindred races should be looked for in the more or less distant part of Turkestan and neighboring lands.

In the purely Aryan period of Turkestan, we find in the first millennium B. C. irrigated oases with settled agricultural population forming several organized states, with the warrior nomads occupying unirrigated areas unsuited to cultivation. It is also recognized that both the settled and nomadic groups belonged to the Iranian branch of the Indo-European linguistic family.⁴⁶

The ancient anthropological indications permit us to conclude that both these branches belonged to *Homo sapiens indo-europaeus* Giuffrida-Ruggieri, but to which branch—brachycephalic or dolichocephalic?

The only known craniological material is that from Anau.⁴⁷ According to Dixon, crania from the upper strata belong to the third millennium or not later than the beginning of the second millennium B. C. and include both brachycephals and dolichocephals in approxi-

⁴⁶ Only very scanty anthropological information regarding these peoples appears, partly in Chinese chronicles, partly in the works of Procopius. (Cf. Veselovskii, p. 11).

⁴⁷ See also Field, Henry, Contributions to the anthropology of Iran. Chicago, 1939. Soviet archeologists planned to recommence excavations at Anau during 1946-1948.

mately equal quantities. It must be remembered that Anau lies far from the area which was first to become Turkized (Jetty-Su), and that it is 2,000 years earlier than the first Turkish appearance in Turkestan. Accordingly, the brachycephaly of Anau cannot be considered to be related to Turko-Mongols.

Although no information is available regarding the linguistic affinities of Anau, its material culture is related to the so-called Tripolje culture. However, by comparing paleoethnological and historical data with the geographic distributions, Oshanin believes it entirely permissible to attribute dolichocephaly to the nomadic tribes engaged in agriculture living in irrigated oases. Oshanin gives the following categories:

1. Long-headed Khwarazmians were mistaken for Guzes (cf. Al-Mukkadisi) by Iranians. However, brachycephaly was customary among Iranians. During the period of Al-Mukkadisi there were no Iranian nomads in Mawerannahr; Arabs found no nomads there at the beginning of the eighth century.

2. Settled Iranians of Khwarazm, who in the tenth century were most probably closely related to the Iranians of Mawerannahr, were originally brachycephalic and obtained mesocephaly only through becoming mixed with the Guzes.

3. Both Plains and Mountain Tajiks (the latter not having come in contact with Turko-Mongols) represent the remains of the ancient Iranian population and are both brachycephalic (cf. Stein).

A. P. Berezin's collection of photographs made by Shults in Piandzh included specimens having Assyroid traits, probably representing *Homo sapiens indo-europaeus* var. *brachycephalicus* subvar. *armeniensis*. Berezin also found a large admixture of light hair and gray eyes in the Pamirs.

Surprisingly enough, the Sarts and Uzbeks, who were subjected to a greater Turkization, were less brachycephalic than the Tajiks.

REASONS FOR SUPPOSING NOMADS DOLICHOCEPHALIC

During the ancient pre-Turkish period we find in Mawerannahr nomadic tribes bearing such names as Sacae, Massagetae, etc. These tribes were known to the Greek authors under the general name Saka or Scythians. The fact that these people used a language of the Iranian branch⁴⁸ is now accepted.

⁴⁸ V. V. Barthold told Oshanin that this cannot be insisted upon in this categorical form, since the latest investigations of N. Marr indicate the possible Japhetic affinities of the Scythians.

While we have no craniological data regarding the ancient Scythians of Turkestan, we have adequate data regarding the Scytho-Sarmatian tribes of southern European Russia. The idea of connecting Turkomans with the Scythians belongs to N. G. Malitskii. Oshanin first attempted to connect the Turkomans with the Dinlins of the Chinese chronicles. The information regarding Dinlins is contained in Grum-Grzhimailo's work entitled: "On the Blonde Race in Central Asia." The possibility of such a connection was suggested by the Turkoman tradition claiming that the original home of the Turkoman people was on the coast of Lake Issyk-Kul. According to the Chinese chronicles, this area was inhabited by the mysterious, apparently Indo-European people known to them under the name of Wusuns [Usu-Ni or Usuns]. Grum-Grzhimailo considers that the Wusuns were the extreme southwestern branch of the long-headed Dinlin group.

There is a mention of Nshun as a family name of one of the Armenian Turki, who are closely connected with the Turkomans, discovered by Barthold in "The Book of Korkud" in the Dresden Library. Aristov (p. 417) identifies this name with the word Wusun. Finally, Thomson⁴⁹ identifies the Uigurs and the Oguzes⁵⁰ as one and the same people. Grum-Grzhimailo considered the Uigurs as definitely belonging to the Dinlin groups.

Thus, the Scytho-Sarmatian tribes were linguistically, philologically and culturally closely related to the Iranian peoples. According to Herodotus, the Sarmatians were but a branch of the Scythians and their language was a Scythian dialect. Oshanin places the Scythians proper between the Boristhenes (Dnieper) to the west and Tenaissus (Don River) to the east; to the east and near Tenaissus extended the ranges of the Sarmatians. One of the Sarmatian tribes, the Alani, reached far east, to the Caspian and Arabian steppes adjoining Khiva Oasis. According to Strabo (first century B. C.) the Sarmatians moved farther west, and having occupied the Scythian lands, gave rise to the mixed Scytho-Sarmatian population of the area.

The craniological material was obtained during the 1870's by Samokvasov and Kidalchick from a tumulus near Aksiutenets close to Romny in Poltava *Oblast*, Ukraine.

Ten out of eleven crania published by A. P. Bogdanov were extremely dolichocephalic; the remaining cranium was extremely brachycephalic and was justly considered to belong to some indeterminate group.

According to Herodotus, in Sarmatia Proper, to the east of the

⁴⁹ Inscriptions de l'Orkhon, p. 148, 1896.

⁵⁰ Another name for the Turkomans.

Don, lived the Osetes,⁵¹ who use an Iranian language and are considered to be the remains of Sarmatian tribes. Ivanovskii, who excavated ancient Osete burials, discovered that 59.9 percent of the crania were dolichocephalic. Gilchenko supposes that these crania belong to the forefathers of the Osetes, the Sarmatian tribe called the Alani. The present brachycephaly of the Osetes, described by Gilchenko (C.I. 82.16; 7.0 percent dolichocephalic; 16.0 percent mesocephalic), is attributed to subsequent mestization with Caucasian peoples.

In his work, "On the Influence of Turki Blood on the Iranian Type of the Osetes," Kharuzin attributes much of this brachycephaly to mestization with the Turki. Dixon believes that not only the dolichocephaly of the Ukraine and steppes to the north of the Caucasus, but also the admixture of dolichocephaly to the south of the Caucasian range, among the Kurds and Osmanli Turks, are due to the migrations of Scytho-Sarmatian tribes.

The Scytho-Sarmatian world ended at the Caspian and Aralian steppes only because that was the extent of geographical knowledge of the ancient authors. We know from other sources relating to Mawerannahr (Persia) and Asia Minor, that the Sarmatian world extended much farther east, for example, the nomadic Iranian tribes. There are no reasons to consider the "Scythians" or "Sacae" wandering over the steppes of Turkestan as distinct from the Scythians of European Russia.

Thus on the basis of anthropological and paleontological evidence we can, with an adequate degree of certainty, suppose that the Iranian tribes which had once wandered in Mawerannahr were dolichocephalic. From the evidence it is also seen that the sole source of dolichocephaly among the Turkomans were these nomadic tribes wandering on the periphery of the irrigated oases.

The information regarding these nomadic peoples ceases at an early date. We know that as late as the eighth century the Arabs who occupied Mawerannahr did not find the nomads. It is probable that part of the nomads went farther south and are possibly represented by the modern nomadic Iranian tribes⁵² of Afghanistan, Seistan, Baluchistan, and Persia. The present small admixture of dolichocephaly was introduced in later years through the nomadic Iranians. This admixture may have begun as early as the second millennium

⁵¹ See Henry Field's forthcoming work, Contributions to the anthropology of the Caucasus.

⁵² Data regarding these tribes were not available to Oshanin. Dixon states that the settled Afghans (the "Pathans") were originally pure brachycephals.

B. C. contemporaneously with the invasion of Persia by the same dolichocephalic element. D. D. Bukinich, who led an expedition into Afghanistan in 1924, noticed that the Iranian nomadic tribes⁵³ to the south of the Hindu Kush were dolichocephalic.

Dixon similarly explains the admixture of dolichocephaly observed in Baluchistan as an influence of nomadic Iranian tribes upon this basically brachycephalic people. Oshanin had no data on the cephalic index of nomadic Baluchis, and none regarding the nomads of Seistan who the Orientalists, according to Barthold, consider to be direct descendants of the Sacae (or Scythians) or of the Se people of the Chinese chronicles, who once wandered through Turkestan.

In modern Persia, there is a great dolichocephalic admixture among the Kurds. Oshanin thinks this is due to mestization of brachycephalic Assyroid (*Vorderasiatisch*) race with the dolichocephalic Iranian (Scytho-Sarmatian) groups. Dixon (p. 309) states that there is a strong admixture of dolichocephaly among the nomadic Lurs⁵⁴ of Luristan. The nomadic Bakhtiariis living between Isfahan and Kermanshah are brachycephalic, but Dixon suggests that the widely practiced artificial cranial deformation may be responsible.

It should be very interesting to investigate thoroughly the above-mentioned nomadic Iranian tribes, since they may prove to be the last remnant of the Scytho-Sarmatian tribes which had once wandered in Turkestan.

A portion of the ancient nomads must have settled down and become mixed with the agricultural population of the oases. Traces of this Oshanin found in the large deviation toward subbrachycephaly and mesocephaly, with a few dolichocephals, arising, in the course of Mendelian bifurcation, among the Sarts and the Uzbeks. That these Plains Tajiks, who have become entirely Turkized in language, and have become mestized with Turko-Mongols, are much less short-headed than the Mountain Tajiks, who escaped mestization with the Turks, Oshanin is inclined to explain by the admixture of the Scytho-Sarmatian dolichocephaly among the Plains Tajiks.

Finally, a large section of Scytho-Sarmatian tribes was very early completely Turkized in language and partly Mongolized in type, yet they preserved in its purity the dolichocephaly of their ancient original types. These people are the modern Turkomans.

⁵³ Oshanin does not know if these were Dzhemshids, and if so, whether the latter are characterized by dolichocephaly. He did not have access to Ujfalvy, who described tribes to the north and south of the Hindu Kush. (H. F.)

⁵⁴ Cf. Henry Field, Contributions to the anthropology of Iran. Field Museum of Natural History, 1939.

From this point of view, the nearest blood relations of the Turkomans are the Osetes. These are the two vestigial lakes remaining from the Scytho-Sarmatian ocean, which once occupied the large territory between the Tien Shan and Pamir-Alai mountain systems in the east and the Dnieper steppes in the west.

The connection of the Osetes with the Scytho-Sarmatians is established on the basis of philological evidence. The connection of the Turkomans with the Scytho-Sarmatian group is established only on the basis of craniological evidence derived from the study of various ethnic groups inhabiting Turkestan and neighboring steppes.

It may also be remarked that the southern Turkomans, who were the least mestized with the Turko-Mongols who had come from the north and northeast, have also preserved in greatest purity the traits of the ancient Scytho-Sarmatian Indo-European physical type. Thus, the average height of the "Teke" Turkomans is 1,700 mm., the tallest in Turkestan; only 20.0 percent were in the short category. Their nearest neighbors are another Indo-European people, the Tajiks, with a mean stature of 1,600 mm., including 33.0 percent short individuals according to Maslovskii.

Mixed Eurasian types occupy an intermediate position as shown by the following table:

Group	Stature	Short Percent	Observer
Sarts	168.0	51.0	Maslovskii, Blagoveshchenskii, Poiarkov
Uzbeks	168.0	32.0	Maslovskii, Ujfalvy
Uzbeks (Khiva)	166.71	?	Oshanin
Sarts (Tashkent)	167.6	?	Shishlov

Purely Asiatic peoples are the shortest, for example, the Kazakhs with a mean stature of 164.0 according to Ivanovskii, Ivanov, and Maslovskii.

The Turkomans, who include many individuals with regularly formed noses, possess a nasal index of 66.6, midway between the Tashkent Sarts (63.06 ± 0.69 with 81.9 percent leptorrhine) and the Khiva Uzbeks (68.0 ± 0.57 with 60.0 percent leptorrhine).

While true light-haired individuals are not known, IAvorskii records 14 of 59 individuals (23.8 percent) having gray eyes, which is a high percentage for Turkestan, excluding the Mountain Tajiks. Oshanin wonders if this is not the last remnant of the trait noticed by Ammianus Marcellinus (XXI, 21 (48)) among the Alans; "Crinibus mediocriter flavis."

COMPARISON WITH HISTORICAL, ETHNOLOGICAL, AND PHILOLOGICAL DATA

Data regarding the Turkomans are very scant. The only original source is the manuscript "Genealogy of Turkomans," by Abul Ghazi Bahadur Khan, written in Khiva during 1659-1660, now in the Tashkent Public Library, translated into Russian by A. Tumanskii.

Abul Ghazi does not doubt that the Turkomans are full-blooded Turks. He quotes legends stating that they have come from the "lands of Al-Malik and Issyk-Kul," i.e., the Jetty-Su.

According to the Genealogy, Turk,⁵⁵ son of Japheth and grandson of Noah, settled near Issyk-Kul, having sought a suitable place for many years. He had started from the shores of Atel (Volga) and Iaik (Ural) where Japheth, son of Noah, had settled after the Flood.

From Issyk-Kul the Turkomans were pushed out by Nainans, Khatais, and Kanglas, and proceeded to settle on the lower course of the Syr-Darya. From there they were forced out by the "Bedjene" people (identified with the Pechenegs). Then they settled in Mawerannahr where they lost their Turkish type and acquired Indo-European traits.

The Turkomans, who had come to Mawerannahr, were first called Turki by the Tajiks. After five or six generations, they became changed under the influence of the earth and the water . . . they became short, their eyes became large, their faces became small and their noses great. When slaves and merchants, from among those who had come into Turkmenistan and settled there, began appearing in Mawerannahr, the difference was seen between them and the Turki. These latter were then so called by the Tajiks and to the first Turks they gave the name "Turkmanend," meaning "resembling a Turki." The plain people who could not pronounce Turkmanend, said Turk (men). . . .

Oshanin thinks that except for "becoming short," the traits enumerated by Abul demonstrate the purity of the Indo-European traits of the Turkomans, which at once distinguished them from the Turki tribes. The southern (Mawerannahr) Turkomans were the least mestized with the Turks. The role played by mestization with the Persian slaves cannot be determined.

Abul Ghazi treats in his final chapter of the seven legendary women who once ruled over the Turkomans. Oshanin wonders if this is not a memory of the ancient matriarchate of the Sarmatians; all ancient authors connect the legend of the Amazons with the Sarmatians. According to Seredonin the word "Sarmad" may have originated from two Iranian words, "Sai"=king and "Mada"=girl.

Aristov agrees with Abul in considering the Turkomans to be pure-blooded Turki genetically related to the Kanglas, and coming

⁵⁵ One of the Scytho-Sarmatians tribes was named Turk.

from Issyk-Kul. Anthropologically this theory is not satisfactory, since the Kanglas later became a part of the Kazakh Hordes, the Kazakhs being extremely brachycephalic. Syr-Darya Kirghiz, who also contain a Kangla admixture, are also 100 percent brachycephalic according to Maslovskii.

The tribal names of the Turkomans are of relatively modern origin. The exception is the "Sakar" tribe, the name of which Aristov connects with the Sakarauk or Sacaraul, the Scythian peoples who, according to the Greek and Roman sources, destroyed the Greco-Bactrian state. Guttschmidt in his "Geschichte Irans" identified them with the Kang-gu people mentioned by the Chinese historians. Modern historians, however, think that the Sakarauks were a nomadic Iranian Scythian people, while the Kang-gu are identified with the Kanglas.⁵⁶ Chinese sources quoted by Bidurin state that in the second century B. C. the Chinese sent an embassy to Mawerannah and Khwarazm to obtain aid against the Huns. About the year 129 B. C., the Chinese Ambassador, Djan Tsan, discovered that the lower and middle course of the Syr-Darya was inhabited by a numerous people whom the Chinese called Kang-gu, whom Aristov identified with the Kanglas. This allows at least 800 years for the Turkization of the Turkomans. Kwarazmians, who now consider themselves pure Turks, were using an Iranian language as late as the eleventh century. Only the anthropological analyses of the modern city and country peoples of the Khiva Oasis disclose their Indo-European racial foundations.

LINGUISTIC AND ANTHROPOLOGICAL CHARACTERISTICS OF THE TURKOMANS

F. E. Korsh, in his classification of Turkish tribes on the basis of their language, divides all Turkish languages into two groups, southern and northern. The southern group is subdivided into the eastern, including mainly the dead languages, Orkhonian of the Yenisei inscriptions, Uiguric, Jagatai, and the language of the Polovtsi, and the western branches. The latter includes the Osmanli, Azerbaidzhan, and Turkoman languages. V. V. Radlov also groups the last three languages together as his "southern" group. Korsh suggests the desirability of checking his philological classification with anthropological data. While in the main the data agree, some discrepancies are observable on the basis of materials available to Oshanin. The anthropological data on the Osmanli Turks are very scanty and sometimes contradictory. They are limited to a few measurements of Turkish

⁵⁶ Oshanin wonders when the Turkomans (Guzes), who used the Turkish language as early as in the tenth century, were first Turkized as to language.

subjects using the Turkish language and inhabiting the Anatolian Plateau. They are characterized by more than medium height and by many (40.0 percent) light-eyed individuals. This admixture is particularly strong among the Bektashi, Kizilbash, and Aizar tribes, all of them living in isolation, according to Arutiunov. Dixon is inclined to attribute this to the admixture of the invaders from the north, the Scythians and Cimmerians. On the other hand, these tribes are not characterized by the dolichocephaly of the Scythians and are, on the contrary, strongly brachycephalic. This may be due to artificial cranial deformation which, according to von Luschan in 1911, is widely practiced among the Takhtadzhis. On the other hand, the dolichocephaly in this case may have been absorbed by the brachycephaly characterizing the peoples of the "Vorderasiatische Rasse." According to Dixon the most brachycephalic group here is the Turkish city population of the Anatolian Plateau; the villagers occupy an intermediary position; the largest admixture of long-headed individuals is found among the nomadic peoples, who Dixon considers to be the descendants of the Turkoman invaders of the eleventh century. However, Eliseev's measurements in 1891, quoted by Dixon in support of this conclusion, do not bear it out.

Eliseev, remarking on the 20.0-percent admixture of dolichocephaly among the Anatolian Turks, shows their craniological heterogeneity. Eliseev states that the greatest percentage of dolichocephaly was found among the city dwellers (32.6 percent), less among the villagers (26.0 percent), and least among the nomads (3.5 percent). Eliseev thought that the Turkomans were typical brachycephals. According to him, the Turkoman nomads in Anatolia have retained the greatest purity of the original brachycephalic Turki types; they do not intermarry with any other tribes. The villagers, and particularly the city dwellers, are less rigorous in this respect. They may have obtained their dolichocephaly from marrying Kurdish and Arabic women.⁵⁷

The question is then raised whether all the Osmanli Turks are related genetically to the Seljuk-Turkomans, and whether there is not present among the Turks of the Anatolian Plateau an admixture of other, later invaders coming, for example, from the north through the Caucasus?

The answer to this question cannot be given until it is known whether all Turkish tribes wandering on the Anatolian Plateau are

⁵⁷ The opposite phenomenon was to have been expected of the Turkomans who were originally dolichocephalic . . . the purity of dolichocephaly would be best preserved among the nomadic tribes; Turkomans settling in cities would absorb brachycephaly of the "Vorderasiatische Rasse." (L. V. O.)

homogeneous both linguistically and anthropologically. The Azerbaidzhan Turks ("Tatars") are far better known from the anthropological point of view.

Dixon, who uses Chantre's data (1892), considers the Azerbaidzhan Turks to be typical dolichocephals, standing alone among the brachycephalic peoples of the southwestern and southeastern littoral of the Caspian. Dixon, who compares the data from Kurdov (1912), Chantre (1892), and Shchukin (1913), concludes that the southern types of Caucasian Tatars differ sharply from the northern. According to Shchukin, the northern group is related to the Nogai Tatars and to the Kirghiz of the Volga steppes, having a sharply expressed brachycephaly. Chantre's and Kurdov's Tatars to the south of the Caucasian range are much taller and show clearly the domination of the dolichocephalic element. Dixon (p. 331) thinks accordingly that the Azerbaidzhan Tatars are closely related, and regards them as the remains of the dolichocephalic element, originally Indo-European as to the language, which were later "partly Tatarized" as to type and completely Turkized as to the language.

This point of view entirely coincides with that of Oshanin, except that the Azerbaidzhan Tatars should be regarded not as an independently Turkized, long-headed Aryan group, but rather as the direct descendants of the Turkomans.

The coincidence of the anthropological, philological, and historical data will become still more obvious if we remember Eliseev's conclusion regarding the distribution of dolichocephaly on the Anatolian Plateau, namely, that it is in general most stable in the southeast, barely noticeable in the center, and completely lost on the west coast.

Beginning in the eleventh century under the leadership of the Suljuk Sultans, the Turkomans terminated five centuries of their penetration of Persia and Asia Minor by conquering Constantinople. Their northeastern group, the Turkomans [of Khwarazm], have retained to the greatest degree the dolichocephaly of the Scytho-Sarmatians. The intermediate group, the Turks of Azerbaidzhan, have partly lost this dolichocephaly, and the westernmost group, the Osmanlis, have lost it to the largest extent, preserving a slight admixture of dolichocephaly only in their easternmost branch. In this process of replacing the hereditary factors of dolichocephaly by the factors of brachycephaly, an important role was played by the peoples of the "Vorderasiatische Rasse."

It remains to find out to which group of Turkish languages belonged the language of the Kanglas, who had completely Turkized the Scytho-Sarmatian nomads. According to Korsh, the Kirghiz language

(the Kirghiz having included the remains of the Kanglas tribes) belongs in the "northern" group of his classification and not the western (Radlov's "southern"), which unites in it the Turkomans, Azerbaidzhans, and Osmanlis. Even in the past, according to Korsh, the Turkoman language was closer to the Jagatai than to the Kirghiz, forming a part of the eastern branch of his southern group. Could this contradiction be eliminated by assuming that the Turkomans embraced the Jagatai dialect only at a later date, when they settled in Mawerannahr?

Polivanov and Korsh demonstrate Iranian elements in the Persian language. According to Polivanov, these elements are distinct from the Persian language proper.

Since this hypothesis, namely that the Turkomans are the remains of the Scytho-Sarmatian peoples, is based on scanty factual materials, it must be considered as provisional.

V. V. Barthold, who examined this work, agrees with it on the main points. He objects, however, to the identification (by Aristov) of the Kanglas with the Kang-gu of the Chinese sources, and states that there is no evidence for this identification other than that of the similarity of the two names. According to Barthold, it is not probable that the Kanglas, like the other Turki tribes, could have come to Turkestan before the sixth century A. D. The Guzes (Oguzes) who, according to Barthold, are correctly thought to be the ancestors of the Turkomans, are Turkish people who had migrated to Turkestan from Mongolia between the sixth and eighth centuries A. D. In the light of this supplementary data, Oshanin is inclined to think that the Guzes became sufficiently intermixed with the Scytho-Sarmatian tribes in the period between the sixth and the tenth centuries to Turkize them completely in language, at the same time acquiring their Indo-European racial type. That such a period of time is sufficient for a loss of an original racial type and for a complete assimilation with another race is seen from the example of the Khwarazmian Uzbeks, who belong to the same physical type as the Tashkent Sarts. In other words they have the anthropological type of the Indo-Europeans (Giuffrida-Ruggieri) with a relatively small admixture of Mongoloid traits.

Another point of view is represented by V. V. Bunak. Having examined this manuscript, Bunak writes that the Turkomans, together with the Kurds, Persian Ajemis (Adzhemis), many Syrians, Arabs, etc., must be considered to belong to the Mediterranean physical type. Anthropologically this is proved by the works of Chantre, von Luschan, and others. According to Bunak's opinion, it is very prob-

able that the Scythians belong to one of the branches of the Mediterranean race. However, these data, unfamiliar to us because of the scarcity of the anthropological literature on Turkestan, do not change the basic tenets. It remains only to state that the dolichocephaly of the Turkomans is the dolichocephaly of that branch of the Mediterranean race which was once represented by the Scytho-Sarmatians.⁵⁸

In the former study Oshanin stated that artificial cranial deformation is not practiced by the Turkomans. However, new data show that the Turkomans themselves explain their dolichocephaly, which is different from the usual head form of their neighbors, by the custom of binding tightly the heads of their newborn children. Data were also forthcoming that this custom is still actually practiced. The Turkomans also state the wearing of tight skullcaps by young children contributes to their eventual dolichocephaly.

In the spring of 1926 the ethnographical expedition of Madame N. V. Briulova-Shaskolskaia, studying the Ersari tribe of the Turkomans on the Amu-Darya between Khodzhabas and Kelif, was joined by Maslov and Fokina who had previously collected anthropological data under Oshanin's guidance in Tashkent.

According to the data collected by Maslov and Fokina during this expedition, the Ersari Turkomans were less long-headed than the Teke Turkomans measured by IAvorskii, yet the Turkomans are still by far the most long-headed people of Central Asia as may be seen from the following table.

People	No.	C. I.	Author	Date
Teke Turkomans	59	75.6	I. L. IAvorskii	1891
Ersari Turkomans	124	77.0	Shaskolskaia Expedition	1926
Khwarazm Uzbeks	100	82.21	Oshanin	1923
Tashkent "Sarts"	119	82.73	A. P. Shishlov	1905
Karategin Tajiks ¹	433	82.77	Central Asian University	1926
Bukharan Central Asian			SREDAZKOMSTARIS	
Jews, Kermine	105	84.45	Expedition	1926
Issyk-Kul Kirghiz	100	84.84	Oshanin	1924

¹ Karategins working in Tashkent.

At the same time it was found out that the Ersari Turkomans always bind tightly the heads of their young children with a folded handkerchief in order, as they themselves state, to make the head as long as possible.

A diagonally folded handkerchief is tied below the occiput in such

⁵⁸ Oshanin, L. V., Nekotorye dopolnitelnye k gipoteze skifo-sarmatskogo proiskhozhdeniia Turkmen [Some supplementary data to the hypothesis of the Scytho-Sarmatian origin of the Turkomans]. *Izvestia*, No. 3, pp. 85-97, 1928.

a way that the most prominent part of the back of the head protrudes above the knot. Oshanin considers it possible that such a manner of bandaging may operate to elongate the skull by causing the protrusion of the occipital region above the bandage. This area of the head of adult Turkomans protrudes very sharply.

For a final solution of this problem it is necessary to study the morphology of Turkoman crania. As far as Oshanin was able to discover, this custom is widespread among other Turkoman people. The following queries arise as to whether:

1. Dolichocephaly can still be considered a racial (i.e., innate) trait of Turkomans, regardless of their tendency to elongate children's heads by means of artificial cranial deformation.

2. This custom, of ancient origin, has been practiced by the Scytho-Sarmatian tribes, whom Oshanin is inclined to regard as linguistically Turkized ancestors of the Turkomans.

3. There are many indications that artificial cranial deformation was practiced in ancient times by any other ancient peoples of Central Asia.

No. 1 may be an attempt to perpetuate the ancient dolichocephalic⁵⁹ type in spite of mestization with brachycephals. The fact that Khwarazm in the tenth century acquired dolichocephals through mixing with the Guzes, shows that the dolichocephaly of the latter was of a hereditary nature.

K. Z. Iatsuta⁶⁰ describes the artificially deformed crania from South Russia. Together with naturally dolichocephalic crania, obviously artificially deformed⁶¹ crania (elongated with a very slant-

⁵⁹ Arabs mentioned the dolichocephaly of the Guzes in the tenth century. In modern times Basmachi bandits, who included together with the Iomud Turkomans some Uzbeks, were asked when captured during the siege of Khiva in 1823, "watermelon or cantaloupe?" If the captive was a "cantaloupe," i.e., long-headed, he was considered to be a Turkoman and dealt with accordingly.

⁶⁰ In Ob iskusstvenno deformirovannykh cherepakh na iugovostoke Rossii. *Izvestia Donskogo Gos. Universiteta*. [No date.]

⁶¹ This "Hippocrates' macrocephaly" has been attributed by various authors to practically every people inhabiting the area near the Sea of Azov: Sarmatians, Cimmerians, Huns, Avars, Armenians, and "Tatars." Similar crania have also been found beyond the boundaries of the Scythian and Sarmatian world, on the Volga near Samara, in many localities of western Europe, and also in Peru, Mexico, and North America. Consequently, the custom of artificial dolichocephaly was practiced by many peoples bearing no relation to the Scytho-Sarmatians. Hippocrates states that the peoples of the Sea of Azov consider dolichocephaly as a mark of nobility and that they used artificial cranial deformation to intensify their dolichocephaly. He also implies that dolichocephaly is inheritable.

ing forehead and extremely protruding occiput) have been found in ancient burials in the Crimea,⁶² in the Don Region, and in the Caucasus.

Kerch crania are attributed to the period from the fourth to the second century B. C. Macrocephalic crania are found in the areas inhabited by Sarmatians, such as Osetia. On the other hand, dolichocephalic crania from Scythian burials and from the ancient burial grounds of Osetia described by Bogdanov⁶³ and A. A. Ivanovskii⁶⁴ do not include artificially deformed crania, so that Scytho-Sarmatian dolichocephaly was of a racial character.

Data regarding other people practicing artificial cranial deformation in Central Asia are found in Chinese sources, which refer to another Scythian people, the Sacae, known to the Chinese sources as Se,⁶⁵ and to their eastern neighbors, known in the western sources as Kushes, Kushans, or Tokharians, and to Chinese sources as Yuechi.⁶⁶

In the history of the Tang Dynasty (seventh-tenth centuries A. D.) quoted by Bichurin,⁶⁷ the following is told of the people of Kuchi (Chinese Kiu-tsi) of the extreme north of eastern Turkestan: "The head of a [new] born boy is pressed by means of a tree."

The same thing is told of the people of Kya Sha (Kashgar): "The people in general are treacherous and crafty. They also depress the heads of male infants in order to make them flat. These people are of tall stature and have blue eyes."⁶⁸

It is, however, impossible to conclude on the basis of these texts whether the practice was to elongate the heads. Bichurin does not give any direct indications that artificial cranial deformation was practiced by the Yuechi. He only states that this custom was widespread in definite areas during definite periods.

However, by analyzing the anthropological composition of the modern population of eastern Turkestan, we come to the conclusion that it has absorbed some elements of *Homo sapiens indo-europaeus dolichomorphus* Giuffrida-Ruggieri.

Stein found that the Indo-European element⁶⁹ predominates in the

⁶² The so-called "Kerch" and "Chersonesus" crania.

⁶³ Poltava burials: IOLEAE, 3, 1880.

⁶⁴ Osetia: IOLEAE, 21, 1891.

⁶⁵ Nothing is known regarding their anthropological type.

⁶⁶ After leaving Jetty-Su they divided into two groups: Little Yuechi, who settled in eastern Turkestan, and the Great ("Da") Yuechi, occupying the area of present Uzbekistan.

⁶⁷ In *Sobranie Svedenii*, vol. 3, p. 218.

⁶⁸ Loc. cit, p. 244.

⁶⁹ Brachycephalic, hypsicephalic, and leptorrhine, i.e., Dixon's Alpine type.

areas closest to the Pamirs (Khotan, Polu, Kok IAr, and possibly in Yarkend and Kashgar). Another Indo-European element still clearly predominates in the Lob Nor area, and east to the Sa Shu area, on the boundary of Kansu Province. However, a large admixture of this dolichocephalic type was found in areas far to the west of this region. So it is that to the east of Khotan⁷⁰ Przewalskii had noticed a large number of blonds among the inhabitants of the Kerian Mountains.⁷¹

Comparing these data, Roland Dixon postulates his hypothesis according to which the dolichocephalic Indo-European type had once been widespread throughout eastern Turkestan, and was only gradually pushed east by the continuous pressure of brachycephalic Indo-Europeans from the direction of the Pamirs and Mongols from the north and northwest.

The Scythians are regarded by several other anthropologists as an ethnic group carrying with it eastward the elements of *Homo sapiens indo-europaeus dolichomorphus*. Thus, Montandon⁷² refers to Haddon's proto-Nordic race as a possible "historical, geographical, and somatological link connecting the modern Ainu with other varieties of *Homo sapiens indo-europaeus*." According to him these proto-Nordics, light-eyed, and above medium stature "aurait été fortement représenté par les anciens Scythes."

The western branch, Yuechi-Tokharians, were known to Byzantine historians under the name of "White Huns" or "Ephthalites." Procopius of Caesarea wrote: "Even though the Ephthalites are a people of Hunnish stock, they have not become mixed with the Huns known

⁷⁰ In the area where the remnants of the Indo-Scythian Tokharian language was discovered.

⁷¹ Grun-Grzhimailo, G. E., *Zapadnaia Mongoliia i Uriankhaiskii Krai*, vol. 2, p. 19. Leningrad, 1926.

⁷² In *L'Anthropologie*, vol. 37, p. 338, 1927, he also refers to the find by A. P. Mostits of two dolichocephalic crania associated with a Scythian cauldron, in Trans-Baikalia (*Izv. Tr.-Kiakh. Otd. Russ. Geo. Ob.*, vol. 3, 1895). A dolichocephalic type is also known in Baltistan, southern Tibet. (Cf. A. H. Keane, A. C. Haddon, and others in *Man, Past and Present*, p. 167, Cambridge, 1920; Ujfalvy, *Les Aryens du Nord et Sud de l'Hindou-Kouch*, p. 319, Paris, 1899). Ujfalvy, Keane, and Haddon regard these people as the descendants of the Sacae. The "Balti are not Tibetans or Mongols at all, but descendants of the historical Sacae, although now of Tibetan speech and Moslem faith." Rock paintings in Baltistan resemble Scythian representations of weapons; this was where a portion of the Sacae, invading India from the north in the year 90 B. C., settled down.

to us. Alone of all Huns they are not of repellent countenance and have white bodies."

This testifies to the Indo-European appearance of the Huns. An attempt to discern the dolichocephaly of the Huns from the effigies on their coins has not been successful. M. E. Masson states that it is difficult to attribute certain coins definitely to the Ephthalites. In addition, the head form of the effigies is hidden by the headgear depicted.

Conclusions.—1. Turkomans practice the custom of binding the heads of babies and explain by this custom their own dolichocephaly.

2. Whether this achieves the desired effect cannot be answered definitely until more information regarding the morphology of the Turkoman skull is forthcoming. According to the preliminary studies of Fokina and Maslov, the dolichocephaly of the Turkomans is due mainly to the relatively lesser lateral development of the skull, something which could hardly take place under the influence of the bandage as described.

According to Oshanin's data, the brachycephaly of the Kirghiz is due to the relatively stronger lateral development of skull, and not to the smallness of its length as, for example:

Group	G. O. L.	G. B.	C. I.	Observer
Issyk-Kul Kirghiz	187.0	159.0	84.84	Oshanin
Ersari Turkomans	188.4	145.0	77.0	Fokina and Maslov

3. Even if it should be proved that artificial cranial elongation of the Turkomans actually takes place, this still would not mean that the dolichocephaly of the Turkomans is not inheritable.

4. The racial (inheritable) character of Turkoman dolichocephaly is clearly indicated by the reference to Al-Mukkadisi.

5. On the basis of historical, philological, and anthropological data, Oshanin considers that the Turkomans have received their dolichocephaly through the admixture of the Guze ancestors of the Turkomans with the Scytho-Sarmatians, whose language they Turkized, but whose physical type they changed but slightly.

6. The custom of intensifying dolichocephaly by means of bandages was widely used by Scytho-Sarmatian tribes, definitely in Europe and very probably in Asia down to the boundaries of eastern Turkestan.

7. It is possible that this custom among the Turkomans is a survival of this widespread custom of their ancestors, the Scytho-Sarmatians.

UZBEKS OF KHWARAZM

Oshanin⁷³ described the anthropological type of the Uzbeks of Khwarazm in the following manner:

Pigmentation.—On this basis these Uzbeks are not homogeneous. Among them clearly predominate darkly pigmented individuals. However, there is a slight admixture of a lighter pigmentation of skin and eyes.

Hair.—Facial and body hair are of medium development. The admixture of individuals with a sparse growth of hair is small.

Face.—The predominating forms are oval and elliptical. The face is of medium height and breadth, with a moderately developed, but not infrequently narrow and low, forehead, more frequently straight and flat than convex and sloping.

Stature.—Medium with a tendency toward tallness.

Facial index.—This varies from euryprosopy to mesoprosopy.

Cephalic index.—Although the mean is subbrachycephalic, there is considerable admixture of both brachycephals and dolichocephals.

Nose.—Medium size predominates. However, there is a small group with low, broad noses. On the other hand, persons with high, narrow noses are frequently encountered. The nasal profile is either straight or convex; concave noses are rarely found. The nasal index is leptorrhine with a strong tendency toward mesorrhiny.

Mongolian fold.—This feature occurs not infrequently.

Summary.—In general, the Uzbeks of Khwarazm may be characterized as representatives of the brachycephalic variety of *Homo sapiens indo-europaeus* of Central Asia, with a significant admixture of Type I (Asiatic type) and a lesser admixture of Type II (dolichocephalic variety of *Homo sapiens indo-europaeus* of Central Asia). This is seen, for example, in the fact that while in all tables of measurements the Uzbeks of Khwarazm occupy an intermediate position between the Tashkent Tajiks and the Uzbeks (i.e., Turkized Iranians) on one side and the Kirghiz on the other, in all basic characters they stand much closer to the Tajiks. The admixture of the dolichocephalic variety of *Homo sapiens indo-europaeus* is expressed in the increased stature and the decreased cephalic indices of the Uzbeks of Khwarazm.

The undoubted, and fairly significant, admixture of Mongoloid traits among the Uzbeks of Khwarazm must be attributed to the preservation of elements of the original Mongoloid Uzbek type which had become dissolved in the autochthonous Indo-European population of Khwarazm.

⁷³ Oshanin, L. V., in Sred. Az. Univ. Bull. No. 17, pp. 97-101. Selected from summary.

This point of view is supported by the fact that in comparison with the Uzbeks of Khwarazm the native population of Tashkent is much less Mongolized. However, the opposite was to be expected from both historical and geographical considerations. The admixture of "Asiatic" inheritable traits among the settled peoples of the oasis was introduced largely by Uzbeks who settled mainly in Khwarazm and Mawerannahr; Tashkent received a relatively smaller admixture of Uzbeks.

KAZAKHS OF THE ALTAI

I Arkho⁷⁴ measured 120 individuals of the Naiman, Kirei, and Kara-Kirei tribes of the Middle Horde Kazakhs, in the Chuiskaia steppes of the southeastern Altai. This is one of the easternmost Kazakh groups. The Chuiskaia steppe is populated by 2,175 Kazakhs ("Kirghiz") who are Moslems, 1,500 Telengets (who represent the ancient Turkish stratum, being an Altaic tribe practicing Shamanism), a few Russians, Tannu-Tuvans (Soiots), and Mongols. The last two are Buddhist groups. Because of religious differences, no mestization is practiced between the Kazakhs and these other peoples.

From the statistical tables the following conclusions have been drawn:

1. The Kazakhs are a strongly brachycephalic (medium-long), and broad-headed euryprosopic (long- and broad-faced), leptorrhine (narrow-nosed) group.

2. These peculiarities differentiate them from many peoples of Asia and the world.

3. This complex of traits places them close to certain tribes of Asia, e.g., the Telengets (in Altai), Buriats, Tannu-Tuvans, Torguts, and possibly the Yakuts.

4. By comparing their morphological peculiarities with those of other brachycephals of Europe and Asia Anterior it is discovered that a significant difference is observed not only in the structure of the facial skeleton, but also in the cranial structure. Thus, the brachycephaly of the Dinaric and Armenoid types (as well as that of some other Asiatic and North American tribes) is determined, to a great extent, by the decrease in head length.

5. Comparison of our data with that of other authors does not show any significant discrepancies. Thus, the analysis of head and facial measurements of the Kazakhs puts them close to certain other

⁷⁴ I Arkho, A. I., *Kazaki Russkogo Altaia: Rasovye tipy Altae-Saianskogo Nagoria. Severnaia Aziia*, Nos. 1-2, pp. 76-99, 1930.

Turko-Mongolian tribes. A particularly close resemblance is found between the Kazakhs and the Buriats.

The following morphological characters were recorded:

PIGMENTATION

The highest percentage of light and mixed eyes was found in the western part of Taval-Darya region and in the southern part of Dashti-Dzhum region. The darkest pigmentation was found in the Kalai Khumb (Piandzh Valley) and the Muminabad regions.

In order to find out whether the blue-eyed Tajiks represented a special type, Ginzburg measured separately a group of adults having eyes of this color (Nos. 12, 14-16 on Martin's scale). It was discovered that in the range of variations of absolute measurements, head and body proportions and indices, and of the descriptive characters of head and face, the blue-eyed group did not differ from all other Tajiks. The only difference was a lighter pigmentation of hair and beard in this group, which consisted of eight subjects. Among the Tajiks from the other regions the darkest-pigmented eyes were found among the Bukharan Tajiks.

The Ferghana Tajiks were but slightly more darkly pigmented than the Mountain Tajiks. Joyce's materials show that the Tajiks of Darvaz are more strongly pigmented than the Tajiks from Karategin. The lightest pigmentation was found in the southwestern Pamirs.

While the Jews, measured by Oshanin, have a larger percentage of mixed eyes than the Tajiks, the former are in general more darkly pigmented than the latter and have a much larger percentage of the darker shades of brown eyes.

The pigmentation of the eyes is darker in the younger age groups, while for the group 24 to 50 years old the commonest shade is No. 4, followed by No. 3; for the ages 18 to 23 the most common shade is No. 3, followed by No. 4 (Martin's scale). The mean shade for the 24- to 50-year-old group was 4.83; for the 18- to 23-year-olds, 3.06.

Turkomans and Kara-Kalpaks are more highly pigmented than the Mountain Tajiks, and less pigmented than the Bukharan Tajiks. In general, the Uzbeks are more strongly pigmented than the Tajiks, but they have a great range of variations. The Kirghiz have a still greater range of variations. The Ferghana Kirghiz are more highly pigmented than the Ferghana Tajiks and much more than the Mountain Tajiks. The Kirghiz from the highland areas of the Tien Shan are pigmented less strongly than even the Mountain Tajiks. Pamirian Kirghiz as well as Joyce's Tajiks from the southwestern Pamirs are

still less pigmented. The Issyk-Kul Kirghiz are very strongly pigmented.

In general, the Mountain Tajiks are somewhat less strongly pigmented than the Plains Tajiks and the majority of other peoples of Central Asia examined in this study. The percentage of light-eyed individuals among Mountain Tajiks is almost identical with that in the other groups.

Eye color

Color	No.	Percent
Dark	59	54.62
Mixed	47	43.53
Light	2	1.85

D. D. Bukinich found a still larger percentage of light and mixed eyes on the Turgaiskaia steppe. S. I. Rudenko found a smaller ⁷⁵ percentage of light and mixed eyes (11.0 percent). This definite admixture of depigmented eyes shows once more the presence in Asia of traces of the mysterious light-eyed type. In contradistinction to other investigators, as for example Ivanovskii, we cannot regard the Kazakhs as a pure darkly pigmented type, but as a dark type with a definite admixture of a mixed type. Among Samoyeds, Buriats, and Torguts the mixed eye color is found much more rarely than among the Kazakhs. The Telengets ⁷⁶ occupy an intermediate place.

Hair color (adults)

Color	Fischer's scale	Percent
Black	27	67.07
Dark brown	4-5	30.61
Light brown	6-7	1.32

Hair color (males aged 18 to 23)

Color	Fischer's scale	Percent
Black	27	52.04
Dark brown	4-5	46.62
Light brown	6-7	2.34

Only one case of lighter hair (No. 10 on Fischer's scale) was observed among the adults. Red hair (Nos. 1-3) was not seen.

Black hair (No. 27) was relatively rare in central and eastern Darvaz, and more frequent in southwestern Darvaz. The Karategin

⁷⁵ IArkho comments that this may be the result of variation in standards followed.

⁷⁶ Cf. IArkho, AZH, vol. 17, Nos. 3-4.

occupied an intermediary position. Dark brown shades were more frequently found in central-eastern than in southwestern Darvaz.

Beard color

Color	Fischer's scale	Percent
Black	27	22.61
Dark brown	4-5	60.14
Light brown	6-7	12.82
Light	8-12	3.26
Red	1-3	1.16

The geographical distribution follows that of hair color. For example, the Pendzhikent Tajiks are lighter; the Pskem Valley Tajiks are still lighter. The Issyk-Kul Kirghiz are pigmented very similarly to the Mountain Tajiks. The Uzbeks of Khwarazm, especially from Karshi and Shakh-rasiab and the Karshi Jews are all more lightly pigmented than the Tajiks. In distribution of Nos. 4 and 27, the Jews are closer to the Tajiks than to the Uzbeks. Beard color is lighter according to IArkho and Oshanin. However, the beards of the Uzbeks and the Jews are darker than those of the Tajiks and do not show as much difference in hair color as among the Tajiks.

In general, the Mountain Tajiks are a light-skinned people, but have strongly pigmented hair and irides; they have a very small admixture of low-pigmented elements. The Tajiks from southwestern Darvaz are more deeply pigmented than the Tajiks from other regions.

BEARD DEVELOPMENT

The distribution of degree of beard growth as recorded on 427 males, aged 24 to 50, was recorded in percentages on the following scheme:

No.	Descriptive category					
0	= complete lack of beard.					
1	= very scanty growth on either chin or cheeks.					
2	= weak growth on chin and cheeks.					
3	= medium growth; growth on cheeks merging into growth on chin.					
4	= well-developed beard, but not strongly spreading onto neck and cheeks.					
5	= well-developed beard, spreading strongly onto neck and cheeks.					
No.	0	1	2	3	4	5
Percentage	1.17	5.15	14.72	28.81	41.69	8.43

Although the general development of the beard was fairly strong, there were 21.0 percent with weak beards. In Darvaz a stronger beard development than in Karategin was found. Tajiks from Bukhara (Oshanin) and Ferghana (IArkho) had a weaker beard development

than the Mountain Tajiks. However, a greater age range was covered by these authors.

The Uzbeks, with the exception of the Khivans, have a much weaker beard development. The Kirghiz have still weaker beards. The beards of Turkomans vary; while the Iomuds have beards as strongly developed as the Mountain Tajiks, the Chaudyrs show a weaker degree of development. The beards of Jews and the Arabs are more strongly developed than those of the Tajiks.

Regarding hair development,⁷⁷ the Darvaz have less growth on the upper lip. The eyebrows of the Darvaz are stronger than those of the Karategin. The amount of chest hair is weak, 31.99 percent being glabrous. The Darvaz had less than the Karategins. Hair on the back was very little, 78.20 percent being glabrous. Pubic hair was also scanty, the Darvaz having less than the Karategins. In general, the body hair was more abundant among the Darvaz. The form of the beard was recorded as: small waves, 49.80 percent; curly, 38.68 percent; deep waves, 9.96 percent; straight, 1.53 percent.

Curly beards were more frequent in central and eastern Darvaz than in Karategin and southwestern Darvaz, where the deep wave was more common. Straight hair was found in a few cases, only in Karategin.

Curly beards were found most frequently in the western part of the Tavil-Darya region, least frequently in the Muminabad region. The Uzbeks of Khwarazm have a much greater percentage of straight-haired beards; among the Issyk-Kul Kirghiz straight beards are in majority.

HEAD FORM

Occiput	No.	Percent
Flat	51	44.4
Round	44	37.9
Prominent	12	10.3
Indeterminate	9	7.8
Forehead	No.	Percent
Strongly sloping	22	18.33
Medium	76	63.33
Straight	22	18.33

BROWRIDGES

Category	No.	Percent
Absent or weak.....	13	10.83
Medium	42	35.00
Strong	53	44.16
Very marked	12	10.00

⁷⁷ The form of the head hair could not be determined because all the heads were shaved.

In comparison with the Buriats and the Tannu-Tuvans, the Kazakhs have strongly developed browridges and a slanting forehead. In addition, we find that the Kazakh group is not homogeneous with respect to this trait, and suppose that with the basic predominating "Altaic" type there had been admixed another type, frequently found among the Buriats and the Tannu-Tuvans.

FACIAL FORM

Shape	No.	Percent
Round and round-oval.....	14	12.07
Oval	60	51.72
Pentagonoid	34	29.31
Square	5	4.31
Others	3	2.58

NOSE

Root	No.	Percent
Low	24	20.16
Medium	90	75.63
High	5	4.20

This also distinguishes the Kazakhs from the Buriats and the Tannu-Tuvans, the majority of whom have low nasal roots.

Profile ¹	No.	Percent
Concave	4	3.36
Straight	56	47.06
Convex	59	49.58
Profile ²	No.	Percent
Concave	30	25.51
Straight	77	64.70
Convex	12	10.09
Nasal tip	No.	Percent
Elevated	20	16.80
Horizontal	61	51.26
Depressed	38	31.93
Nostril	No.	Percent
Round	6	5.04
Triangular	46	38.65
Oval	63	52.04
Indefinite	4	2.36
Height of alae	No.	Percent
Low	19	16.24
Medium	72	61.54
High	26	22.22

¹ Of bony part of the nose.

² Of nasal cartilage.

This average Kazakh type of nose, possessing a medium-prominent nose root, straight or convex profile, slightly drooping tip, oval-triangular form of nostrils, medium slanting, with medium alae with below-medium flare, differs from Buriat and Tuvan Mongol type of nose, having a low root, concave-straight profile, tilted tip, rounded-triangular, almost horizontal nostrils and low alae. A strong suspicion is aroused that this group originated from the mixing of two groups, one of which had a Mongoloid, the other a Europeoid form of nose.

LIPS

The Kazakhs have thinner lips than either the Buriats or the Tannu-Tuvans.

EARS

The ears protrude markedly in 89 cases (76.07 percent), the remainder being in the medium category. The lobes do not agree with the prevailing Mongolian type. For example, 54.16 percent were tongue-shaped, 25.0 percent horizontally truncated, and 20.84 percent triangular. In general, the ears were usually egg-shaped with a certain percentage of pear-shaped forms; greatly protruding, with a well-developed helix, medium-developed anti-helix, and well-expressed lobes. All these points differ from those of the Mongoloids, and are specific for the Kazakh type.

SUMMARY

The Mongoloid peoples of North Asia fall into several distinct groups. More clearly distinguished are the "Ugrian" type described by Rudenko, having a long, narrow, low skull, and very typical structure of the soft parts of the face; and the "opposite" type, eurycephalic, with a long and broad face, typical for many Turko-Mongolian peoples. We shall compare the Kazakhs with the type of other Turko-Mongolian peoples in an attempt to find out whether these are formed on the basis of one variety of the Mongol race, or on the basis of several.

Our Kazakhs, who are very close to Kharuzin's Kazakhs of the Bukeyevskaia Horde, are to be compared with the Buriats observed by Talko-Grintsevich, Porotov, the Shendrikovskii and the Tannu-Tuvans⁷⁸ measured by IArkho in Kemchik.

⁷⁸ IArkho, A. L., *Kemchikskie Tannu-Tuvintsy. Severnaia Aziia*, Nos. 5-6, 1929.

This peculiar combination of traits among the Kazakhs forces us to answer the query regarding the identity of Turko-Mongolian tribes in the negative.

Thus, IArkho finds two basic types, and one mixed type. He attempts by combining forehead, lips, nose, and face form (Saian, rounded and round-oval; Altaian, oval and rectangular) to divide them by morphological characters, and finds five such combinations.

Measurements and indices of 120 Kazakhs¹ of the Altai

Measurements	Range	Mean	S. D.	C. V.
Stature	145-181	163.00	7.11	4.36
Head length	175-206	188.20	6.73	3.57
Head breadth	149-174	160.70	5.01	3.11
Head height	113-143	127.90	6.30	4.92
Bizygomatic diameter	137-167	151.40	5.67	3.80
Bigonial diameter	103-132	115.60	6.52	5.62
Nasal height	40-68	55.40	4.72	8.52
Nasal breadth	27-46	36.65	2.92	7.95
Ear length	52-76	64.30	4.41	6.85
Ear breadth	29-42	35.30	2.48	7.02
Indices				
Cephalic	75-98	85.40	3.47	4.06
Nasal	43-74	58.25	5.78	9.92
Ear	42-76	55.35	4.94	8.92

¹ Age range was 21 to 60.

The supplementary types in the Kazakhs may include, theoretically, the Ugrian and the Samoyed, as supposed by Aristov. Without any doubt there should be included the brachycephalic European type, which IArkho calls Pamiro-Ferghan, of the Tajiks and which is more frequently found among the western Kazakhs and the Kirghiz.

The Mongolian type is called provisionally the "Saianic,"⁷⁹ indicating by this a complex of descriptive characters distinctive from the "Altaic."

ALTAIC TYPE

Kharuzin pointed out the European (Caucasian) character of this type. The following facts may be adduced in support of this position:

1. Large admixture of depigmented eyes, especially if we eliminate the darker Saianic eyes.
2. Slight intensification of tertiary hair covering, i.e., beard.

⁷⁹ IArkho also describes a "Saianic" variant of the Central Asiatic racial type among the Tannu-Tuvans from Kemchik.

3. Relatively slight development of upper eye fold and low percentage of epicanthic fold.

4. Prominent nose.

Comparative table of descriptive characters

Pigmentation:	Kazakhs	Tuvans and Buriats
Hair	Dark.	Dark.
Eyes	Dark, with large admixture of mixed shades.	Dark with small admixture of mixed shades.
Hair texture	Coarse medium.	Coarse.
Beard quantity	Small but with admixture of higher quantity of growth.	Very small.
Occipital form	Flattened-rounded.	Flattened-rounded.
Forehead	Broad, slightly inclined.	Broad, rounded, straight.
Browridges	Strongly expressed.	Weakly expressed.
Face form	Oval or long pentagonal.	Round, round-oval, round-pentagonal.
Horizontal profile	Weak, with large percentage of medium.	Very weak.
Eye opening	Narrow, admixture of medium.	Narrow.
Upper eye fold.....	Medium over entire extent without reaching eyelashes.	Medium over entire extent reaching the eyelashes.
Epicanthus	Small.	Relatively frequent.
Nose root	Medium prominent.	Flat.
Nasal profile	Straight or convex.	Straight or concave.
Tip elevation	Horizontal with tendency to depression.	Horizontal with tendency to elevation.
Nostrils, form	Tendency to be elongated.	Tendency to roundness.
Nasal wings	Medium.	Tendency to low.
Nasal wings, development...	Below medium.	Weak.
Lip height	Above medium.	High.
Lip thickness	Below medium, many thin.	Tends to be broad.
Teeth, anomalies	Frequent.	Rare.
Ear form	Egg-shaped or pear-shaped.	Pear-shaped.
Helix	Well developed.	Medium developed.
Lobe	Well developed.	Below medium.
Protrusion	Great.	Great.

ARGUMENTS AGAINST EUROPEOIDAL AFFINITY

1. Broad face. The admixture of narrow faces, according to IArkho, lowers the facial width proportionately to the extent of the admixture.

Author	Homogeneity	Racial affinity and composition
Kharuzin	Not homogeneous.	Formed by interbreeding of Mongolian and Caucasian type. Typical average type of Kazakh is a product of mestization
Seland	Not homogeneous.	Agrees with Kharuzin.
Ivanovskii	More or less homogeneous.	Belongs to the Central Asian group of Ivanovskii's classification.
Deniker	?	Belong in Turkish race; together with the Ugrian race from Eurasian racial group. Turkish race (Deniker) is distinguished from Mongol race proper.
Giuffrida-Ruggieri ¹	?	Belong to <i>Homo sapiens asiaticus</i> var. <i>centralis</i> together with Buriats, Kirghiz, Torguts, etc.
Bukinich (1924)	Not homogeneous.	Original, yet closer to Mongolians.
Rudenko (1927)	Not homogeneous.	Belong in Central Asiatic group together with Altaians. Analysis of distribution curves shows non-homogeneity, in stature and nasal index.
Larkho (1927)	Not homogeneous.	Basic type is Turki (South Siberian); with this is mixed a certain percentage of Mongolian (Central Asiatic type) and a small amount of Europeoidal Pamiro-Ferghan type.

¹ He places Tannu-Tuvans in another variety, *Homo sapiens asiaticus palcarecticus* var. *brachymorphus*, close to Samoyeds, but with the nasal index close to *centralis*.

2. Mandibular breadth.
3. The entire complex of characters typical for Asia.

I Arkho does not believe the validity of the data on the nose and epicanthic fold. There are also insufficient data on pilosity, which may result from Pamiro-Ferghan admixture since the hairiness appears to be higher among the western Kazakhs. Depigmentation may be natural to the Altaic type or may be due to a very ancient admixture. The structure of the head and face includes the Kazakhs in the Mongoloid cycle.

The Altai variety of the Mongol race apparently coincides with Deniker's Turkish race, "supplementing and expanding its stingy but neat definitions."

The following are regarded as specialized traits: great stature; modeling of skull; prominent nose; structure of lips; ear (reduction of the helix); and probably depigmentation. This indicates that our Altaic type approaches the Turkish race as characterized by Deniker: "The Turkish race may be characterized in the following manner: stature above medium (167.0-168.0) brachycephaly (81.8-87.0); face oblong, oval; eyes non-Mongol, but frequently with an outer eyefold; hair covering moderately developed; broad cheek-bones, thick lips, straight and relatively prominent nose."

In the future we shall attempt to elucidate the role of the Mongol race in the formation of other peoples of Altai and Saian, and also shall give a craniological verification of our positions. The problem of the historical genesis of this type will be solved by paleoanthropologists. In this connection much is expected from the study of the crania collected by S. A. Teplukhov from the ancient graves in the Minusinsk region.

Since ancient crania of Turkish type have been found as far apart as Trans-Baikalia (Talko-Grintsevich) and South Russia, the distribution of this type in Eurasia must have been very wide. A mestization resulting in the origin of the Altaic type consequently is not excluded, but such a mestization may have taken place at a very early period.

Due to the localization of the described "Altaic" type in the steppe zone of South Siberia, I Arkho proposes that it be named *Homo sapiens asiaticus* var. *sibirica meridionalis*.

The Saianic type (subvar. *saianica*) is a local variant of a wider complex which is best described as "Central Asiatic" (var. *centralis*).

Thus, in the foundation of the race genesis of our Kazakhs lies a basic specific type corresponding to Deniker's Turkish race. In addition, the following races took part in the formation of the Kazakh type: Central Asiatic—Mongoloid—and, to a very small degree, the Europeoid Pamiro-Ferghan complex.

WESTERN KAZAKHS

Rudenko⁸⁰ observed that the study of the Kazakhs (Kirghiz-Kazakhs) is of many-sided interest. The Kazakhs, one of the most numerous Turkish peoples, have, better than the other Turks, preserved their ancient way of life and, most probably, their physical type.

In analyzing the physical type of the Kazakhs, it may be possible to determine the basic type of the Turks as well as the foreign admixtures which entered into their composition.

All earlier measurements were based on very little material, dealing almost entirely with adult males. Zeland⁸¹ measured 10 male and 10 female Kazakhs and 30 male Kara-Kirghiz of the Semireche (Jetty-Su) region. Ujfalvy⁸² measured 11 male Kazakhs and 26 male Kara-Kirghiz of Ferghana. Matseevskii and Poiarkov⁸³ measured 30 male Kazakhs in Kuldzha; Tronov⁸⁴ measured 36 male and 13 female Kazakhs of the Middle Horde; Kharuzin,⁸⁵ 157 male Kazakhs of the Lesser (Bukeevskaia) Horde, Ivanovskii,⁸⁶ 126 male and 30 female Kazakhs of the Middle Horde.

Thus, we have data regarding 426 male and 53 female Kazakhs and Kirghiz taken together. Of the investigators mentioned, only Ivanovskii gives summary data for individual clans, while the clans of the groups investigated by other authors are not known.

However, we know that the Kazakhs formed an independent people, consisting of only several tribes by the middle of the fifteenth century.

⁸⁰ Rudenko, S., *Osobennosti zapadnykh Kazakov*, in *Akademiia Nauk S.S.R. Materialy osobogo komiteta po issledovaniiu soiznykh i avtonomnykh respublik*, No. 3, pp. 83-221, 1927.

⁸¹ Zeland, N. L., *Kirgizy*. *Zapiski Zap.-Sibir. Otd. Russ. Geog. Ob.*, vol. 7, No. 2, Omsk, 1885.

⁸² Ujfalvy de Mezö-Kövesd, *Le Kohistan, le Ferghanah et Kuldja*. Paris, 1878.

⁸³ Matseevskii and Poiarkov, *Etnograficheskie zametki o tuzentsakh byvshego Kuldzhinskogo raiona*. Omsk, 1883.

⁸⁴ Tronov, V. D., *Materialy po antropologii i etnologii Kirgiz*. *Zap. Imp. Russ. Geog. Ob.*, po *Otd. Etnogr.*, No. 2, St. Petersburg, 1891.

⁸⁵ Kharuzin, A. N., *Kirgizy Bukeevskoi ordy*. *Trudy Antr. Otd. Imp. Ob. Liub. Est., Antr. i Etnog. Imp. Mos. Univ.*, vol. 14.

⁸⁶ Ivanovskii, A. A., *Kirgizy Srednei ordy*. *Razh.*, vol. 14, No. 2, 1903.

At that time, in connection with the breaking up of the Djuchi *Ulus* (that is, the domain of the elder son of Genghis Khan, Djuchi Kahn), when the independent Khanates of the Crimea and Kazan were formed in the western half of the *Ulus*, the Kazakh Federation came into being with the death of Abul Khair Khan in the third quarter of that century. The first to secede from Abul Khair Khan were the Sultans Girei and Djannibek, who were joined by some of the clans. With the death of Abul Khair Khan and the final breaking up of the eastern half of the *Ulus*, a portion of the clans forming the *Ulus* joined the Kazakhs who had rallied about Sultans Girei and Djannibek. Somewhat later, the Kazakh Federation was joined by the majority of the Dasht-i-Kipchak clans.

Thus, the Kazakh Federation was formed by various tribes and clans, whose international administration was in the hands of their elders and was based on their separate customary law.

On the basis of historical data and from the study of the present-day composition of Turkish tribes and peoples, Aristov states that the main tribes forming the Kazakh Federation were:

1. Great Horde: tribes Dulat, Kangly, Kirghiz.
2. Middle Horde: tribes Kirei, Naiman, Argyn, Kipchak.
3. Lesser Horde: tribes Alchin, Baiuly, Jettru.

In all probability, even while still in the Altai, and later, when coming into Mongolia and into the so-called Kirghiz steppe in the west, the Turkish tribes intermingled in a greater or lesser degree, forming complicated tribal and clan federations.

Nevertheless, it is most probable that the study of modern clan subdivisions of the Kazakhs will uncover their tribal origin. Without attempting to treat of the tribal and clan subdivisions of the Kazakhs in general, Rudenko enumerates such subdivisions of the Kazakhs among whom he and his colleagues have conducted anthropological investigations.

In 1921, 496 Kazakhs were measured in the Kustanai canton (*uezd*) of the Turgai region. These data have not been published. In the summer of 1924 Rudenko measured 20 male Kazakhs in the Chuiskaia steppe during the Altai Expedition of the Russian Museum. During the summer of 1926, 827 Kazakhs of both sexes were measured in the government of Aktiubinsk and, partly, in the Adaevsk canton, by the Anthropological Section of the Kazakhstan Expedition of the Academy of Sciences under the leadership of Rudenko. The following anthropometric data give an idea as to the volume of observations: 233 individuals were measured in great detail, 496 in less detail, and 594 according to a simplified schedule. The Kustanai canton and Chuiskaia

steppe groups were measured by Rudenko, the Aktiubinsk and Adaevsk groups by M. N. Komarova and L. K. Kornilov. Our investigations have covered in the main the Kazakhs of the Lesser Horde; the Kazakhs of the Middle Horde were studied only in part.

The Kazakhs of the Naiman tribe, measured in the Chuiskaia steppe belong to the Middle Horde. The number of individuals measured is so small that Rudenko postpones any interpretations of these materials until more substantial investigations of the eastern Kazakhs have been made. Part of the individuals measured in Kustanai canton belong to the Kipchak tribe, which also belongs to the

Tribal subdivisions of Kazakhs measured

1. *Baidy*

Adai Akbota, Balykshli, Baipak, Begci, Esenbet, Zhary, Zhemenci, Isek, Karazhan, Krykmylytk, Kosulak, Konanorys, Mugal, Tazike, Turkpenadai, Tobysh, Turkpen, Shegem.

Alasha.

Baibakty.

Bersh.

Zhappas Nauruz.

Esentemir.

Taz.

Tana.

Sherkesh.

Ysyk.

2. *Alimuly*

Alim Akbura, Maimbet, Kabak, Karash, Karakesek, Kenzhe, Mailibai, Nazar, Ryskul, Tleu, Shuren.

Kete Ozhirai, Uak.

3. *Jettru*

Zhagalbaily Tleu, Shagyr.

Kerdery.

Tabyn Aidyr, Kedeikul, Kozhantai, Medet.

Tama Kulan.

Middle Horde. The Kipchaks are one of the ancient Turkish tribes of the group in which Rashid-ud-Din (fourteenth century) also enumerates the Uigurs, Kirghiz, Karlyks, and other tribes. Long before the Mongol invasions, the Kipchaks were a numerous tribe wandering on the steppes between the Don, Volga, and the Urals, and giving their name to the steppe (Dasht-i-Kipchak—"The Kipchak Plain"). The number of Kipchaks decreased greatly as a result of great masses of them in the west becoming a part of the Bashkirs, Nogais, Crimean and Volga Tatars, and of further groups of Kipchaks, because of their part as the mainstay of the Juchid domination, going southwest with the Sheibanid armies to form the principal

part of the Uzbeks particularly in Ferghana, between Zarafshan and the Amu, and also in Khiva.

The tribal composition of the Lesser Horde is very heterogeneous, since the Horde was formed of many fragments of various Turkish tribes. According to Tevkelev's Memorandum (1740) the Lesser Horde for a long time consisted of one tribe, the Alchin, which was divided into two tribal groups, the Alimulin and the Baiulin; seven smaller tribes joined the Alchins. These seven tribes formed a union only at the end of the seventeenth or the beginning of the eighteenth century, when Khan Tiavka, who died in 1717, united them into one tribal group of Jettru "seven clans." Of the tribes forming the Jettru group, two, the Tabyn and Tama, are also found among the Bashkirs and the Uzbeks. The investigations covered the Baiuly group (north in Kustanai canton and south in the Aktiubinsk region) and the Alimuly and Jettru groups.

The above groups are exogamous within clans, but endogamous within tribes and tribal subdivisions.

PIGMENTATION

Skin color.—Using von Luschan's scale, the color of the chest on areas normally covered by clothes: light (Nos. 7-13) and dark skins (Nos. 5, 6, 14-18, 22-25) were evenly divided.

Eye color.—According to Martin's scale the eyes were predominantly brown: 85.8 percent men, 96.0 percent women; of that number, 40.1 percent of the men and 62.8 percent of the women had dark brown eyes. There was no significant difference between the tribal groups. More women than men had dark eyes.

Eye color	No.	1	2	3	4	5	6	7	8	9
Baiuly	125	1	12	39	43	12	12	3	2	1
Alimuly	143	0	18	47	37	24	2	7	8	0
Jettru	36	0	2	8	11	7	6	1	1	0
	—	—	—	—	—	—	—	—	—	—
Total	304	1	32	94	91	43	20	11	11	1

Hair color.—The hair was dark in the overwhelming majority of cases; of 448 adult males only 2, and of 402 women only 3, had light brown hair with dark eyes.

Combined hair and eye color.—The dark type having eye color Nos. 1-5 and dark hair definitely predominates: 90.2 percent of the men and 96.3 percent of the women. A larger admixture of the mixed type was found among the southern Baiuly (Aktiubinsk and Adaevsk regions) and the Jettru men. Comparable results were obtained by Kharuzin for the male Kazakhs of the Bukeev ("Lesser") Horde, and Ivanovskii for the Middle Horde, 97 percent of the dark type for the

former, 95 percent for the latter. This endows with a still greater interest the considerations regarding the admixture among the Kazakhs of the legendary blond race, the Dinlins, found in the Chinese chronicles.

Aristov⁸⁷ states that the history of the Tang Dynasty written in the ninth century on the basis of earlier sources, in connection with a description of the Yenisei Kirghiz, says that "the inhabitants of that land have become mingled with the Dinlins . . . are generally tall, with red hair and pink faces and blue (green) eyes. . . ."

According to Aristov, Dinlin admixture may be found among the Tele, Merkit, Kirei, and a Lesser Horde tribe, the Alchin. Judging by the name, the Alasha tribe of the Baiuly group must also be of Dinlin origin. The data on the pigmentation of the Kazakhs at our disposal do not corroborate the supposition of a blond admixture among the Kazakhs. Whatever the case, this problem can be more appropriately examined when we have data regarding the physical type of the eastern Kazakhs and the Kirghiz, among whom, on the basis of historical information, the admixture of the Dinlins was much more probable.

STATURE

In the great majority of cases the stature was medium or below medium (164.0 for men and 151.0 for women). While the individual range of variation was relatively broad, there was no significant difference between the means obtained for various tribal groups. A somewhat greater stature was found for the men of the Jettru group, which also had women of a somewhat smaller average stature than the average for the other Kazakh groups. The average stature noted by Kharuzin for the men of the Lesser Horde was 162.9, i.e., very close to our figures for the Lesser Horde. Ivanovskii found a mean stature of 165.1 for the Kazakhs of the Middle Horde, which is somewhat higher than the figure for the Lesser Horde. This may be explained by a higher percentage of the Jettru group among the former.

Group	No.	Range	Mean	Short	Medium	Tall	Very tall
Baiuly A.	132	147.0-178.2	163.68	28.8	30.3	24.2	16.7
Baiuly K.	80	146.6-179.0	163.36	28.7	27.5	30.0	13.8
Alimuly	141	146.9-179.4	164.14	25.5	26.2	29.8	18.4
Jettru	65	153.7-178.7	165.70	24.6	21.5	24.2	24.6
Kipchak	48	150.3-175.0	163.62	25.0	27.1	37.5	10.4
Total or mean. . .	466	146.9-179.0	164.32	26.8	27.0	28.0	17.2

⁸⁷ Aristov, N., *Opyt vyiasneniia etnicheskogo sostava kirgiz-kazakov Bolshoi ordy i kara-kirgizov*. Zhivaiia Starina, Nos. 3-4, 1894.

From the distribution curve (bimodal maxima at 162.0 and 166.0 for the men and 148.0 and 152.0 for the women) it is possible to assume the presence of two elements, differing in stature; the low element is most sharply pronounced among the southern groups (Aktiubinsk, Baiuly) and is also found among the Kustanai Baiuly and the Jettru. The tall element is most clearly present among the Alimuly, and is also found among the Kustanai Baiuly and the Jettru.

CEPHALIC INDEX

The overwhelming majority are true brachycephals (85.86 for the men; 86.87 for the women) with a very small percentage of subbrachycephals and only an exceptional mesocephal.

Group	No.	Range	Mean	Meso.	Sub-brachy.	Brachy.
Baiuly A.....	128	79.1-95.4	86.35	3.90	12.5	83.60
Baiuly K.....	80	75.6-91.3	84.80	6.25	20.00	73.75
Alimuly	141	78.0-96.1	86.13	4.26	15.60	80.14
Jettru	65	78.2-82.2	85.32	4.61	23.08	72.31
Kipchak	48	79.5-89.1	84.53	4.16	29.17	66.67
Total or mean...	462	75.6-96.1	85.86	4.54	17.96	77.49

Only slight variations were noticed by tribes: the Kipchak males and their neighbors, the Kustanai Baiulys, are less brachycephalic than the other tribal groups. Kharuzin gives the average index of 86.28 for the Lesser Horde (brachycephals 82.0 percent; brachycephals and subbrachycephals together 96.0 percent). Ivanovskii's Middle Horde Kazakhs (clans Kirei, Naiman, Baidzhigit, and Murun) had an average of 89.39 (91.0 percent brachycephals and 99.0 percent brachycephals and subbrachycephals together). However, Rudenko's Middle Horde Kazakhs (Kipchak clan) averaged 84.53, while 33.33 percent of individuals were mesocephalic and subbrachycephalic. No data are available for the Great Horde.

HEAD BREADTH

The mean head breadth was 160.46 for males.

Group	No.	Range	Mean
Baiuly A.....	129	147-175	160.74
Baiuly K.....	80	149-172	159.35
Alimuly	141	143-174	160.62
Jettru	65	146-177	161.06
Kipchak	48	147-174	159.92
Total or mean.....	463	143-177	160.46

The tabulation of differences by tribes does not disclose any sizable difference between groups. The Kazakh groups investigated were found to be relatively homogeneous both in head form and in absolute head dimensions.

FACIAL INDEX

The majority were euryprosopic (men, 80.80, 74.1 percent; women 80.77, 77.3 percent). Of men, 18.4 percent, and of women, 16.4 percent, were mesoprosopic. Of men, 7.5 percent, and of women, 6.2 percent were leptoprosopic.

While the number of observations is probably not quite sufficient for a positive statement, certain differences in the facial indices of various tribes have been noted. The broadest faces were found among the Kipchaks and the Kustanai Baiuly; the greatest tendency toward

Face width	No.	Range	Mean
Baiuly A.....	131	134-160	148.86
Baiuly K.....	80	134-165	149.10
Alimuly	141	128-160	148.84
Jettru	64	138-162	149.44
Kipchak	48	138-159	149.58
Total or mean.....	464	128-165	148.98

Facial index	No.	Range	Mean	Eury.	Meso.	Lepto.
Baiuly A.....	131	72.9-90.4	81.22	71.0	20.6	8.4
Baiuly K.....	80	69.0-92.0	79.66	81.2	10.3	7.5
Alimuly	140	69.3-90.8	81.12	75.7	19.3	5.0
Jettru	64	70.9-96.0	82.59	59.1	25.0	15.6
Kipchak	48	68.0-87.5	78.38	87.5	12.5	...
Total or mean....	463	68.0-96.0	80.80	74.1	18.4	7.5

leptoprosopy and mesoprosopy was observed among the Jettru. On the basis of the distribution curve, we can assume among the prevalently broad-faced Kazakhs an admixture of some mesoprosopic element. Because of the limited character of the data, this may be definitely shown only in the case of the Aktiubinsk Baiuly (men) and Alimuly (women); the women as a rule are more broad-faced than the men. Ivanovskii's observations on facial form on the Middle Horde were made on the basis of the physiognomic index and not the anatomical, as were Rudenko's. Nevertheless, his data do not contradict those of Rudenko, the great majority of the Middle Horde Kazakhs being euryprosopic, with a very small percentage in the leptoprosopic category, and the women being more broad-faced than the men.

The facial index of the Kazakhs depends on their very great absolute facial breadth (mean for both women and men 148.98). No significant variation in facial breadth was discovered between the various tribal groups, with the possible exception of the somewhat less broad-faced Jettru women.

NASAL INDEX

All Kazakh groups, in spite of their broad faces, are mesorrhine with a leptorrhine tendency. The average for men is 71.64 (56.1 percent), and for women 71.62 (52.2 percent). Of men, 40.8 percent, and of women, 44.5 percent were leptorrhine. In the platyrrhine category there were 3.0 percent males and 3.3 percent females. A slight tendency toward narrower noses is discernible among the Alimuly and Jettru groups, both in the mean nasal index and in the number of leptorrhines.

The distribution curves show the undoubted presence of two elements among the Kazakhs, one leptorrhine, and the other, predominating, mesorrhine. The two elements are found in all tribal groups, but are most clearly discernible in the case of the Aktiubinsk Baiuly and Alimuly. Nasal indices for the Middle Horde recorded by Ivanovskii do not differ materially from Rudenko's groups (71.78; leptorrhine, 54.0 percent; mesorrhine and platyrrhine together, 46.0 percent). Platyrrhines account for only 8.0 percent of the women (mean 72.25).

The nasal height (nasion-subnasale) is 53.16 for males, 48.38 for females. No material difference in this respect had been observed between tribes, with the exception of the Kustanai Baiuly (men and women) who, having a nasal index similar to the other groups, had somewhat lesser absolute nasal dimensions.

Nasal length	No.	Range	Mean					
Baiuly A.....	132	45-63	53.10					
Baiuly K.....	79	45-60	51.73					
Alimuly	140	44-67	53.52					
Jettru	65	40-66	54.96					
Kipchak	48	46-63	52.54					
Total or mean.....				464	40-67	53.16		
Nasal index	No.	Range	Mean	Lepto.	Meso.	Platy.		
Baiuly A.....	132	57.4-90.0	72.30	35.6	61.3	3.0		
Baiuly K.....	79	55.4-88.9	72.08	36.7	60.8	2.5		
Alimuly	139	50.0-92.5	70.76	46.0	50.3	3.6		
Jettru	65	56.3-85.5	70.32	50.7	47.7	1.5		
Kipchak	48	55.9-88.6	72.96	33.3	62.5	4.2		
Total or mean....			463	50.0-92.5	71.64	40.8	56.1	3.0

CONCLUSIONS

Rudenko's Kazakh group is characterized by dark and light skin; dark hair and eyes; medium stature; obvious brachycephaly, euryprosopy, and mesorrhiny tending toward leptorrhiny. From the analysis of the distribution curves, it is seen that two elements are indicated among both men and women: tall and short; narrow-nosed and with a nose of medium breadth, the latter group (i.e., the mesorrhines) being also characterized by a relatively broader face.

Only preliminary considerations may be advanced regarding the racial type and tribal composition of the western Kazakhs. There are three points of view regarding these problems:

Kharuzin⁸⁸ writes that they not only lack ethnological and anthropological unity, but also do not have any numerically strong nucleus around which other elements could become grouped. According to him, the Kazakhs are in the process of being dissolved in numerous Turkish, Mongolian-Turkish, and even other (Usuns or Wusun) tribes. This conglomerate character of the Kazakhs Kharuzin explains by geographical conditions, i.e., the steppes.

In another work while denying that the Kazakhs have a strictly definite type, Kharuzin states that there is an average predominating type among them, and proceeds to describe it. In addition to this type, he also states that among the Kazakhs are encountered individuals leaning toward either the Mongolian or the Caucasian race.

Criticizing Kharuzin's position, Ivanovskii, who does not think that the anthropological data indicate a high degree of mestization, lack of pure type, etc., among the Kazakhs, favors vaguely the idea of relative homogeneity of the Kazakh type.

Aristov, after examining Kharuzin's conclusions, supposes that the predominating type described by Kharuzin among the Kazakhs must be considered to be a Turkish (Turki) type. The other two types he is inclined to consider to be the western Dinlin and the Finno-Ugrian type. At the same time he thinks that the historical, ethnographical, and philological considerations and data also indicate traces of the Samoyed type.

Comparing the anthropological traits of the Kazakhs described above by Rudenko with the corresponding, partly published data regarding the Uralian, Altaian, and western Mongolian Turks and with some of the Mongol tribes, it is not difficult to observe that they are all possessed of common morphological peculiarities, and ap-

⁸⁸ Kharuzin, A., *K vosprosu o proiskhozhdenii Kirghizskogo naroda*. Etnograficheskoe Obozrenie, 1895, p. 26.

parently all belong in the same, fairly stable, race. It is very probable that there exist local and tribal variations of this race, which we shall conditionally call the "Central Asiatic race," owing to incorporation within themselves of native (sometimes of ancient origin) elements, to mestization with representatives of other races, and to the variability of their own race.

Further study is necessary, especially of the Turkish and Mongol tribes, in order to identify the race that interests us, after which it will not be difficult to discover the nature of the admixture. In order to solve the problem of the disappearance of certain racial types, such as the Dinlins or Wusuns, if the information contained in the Chinese chronicles is accurate, or even to trace the evolution of the racial type of the Kazakhs, it is necessary to study the "large families" and other similar problems.

TURKOMANS OF KHWARAZM AND THE NORTH CAUCASUS

I Arkho⁸⁹ gives the following summary for the Iomuds and the Chaudyrs of Khwarazm (Khoresm) and the Caucasus:

Iomuds.—Stature: above medium. Eyes: dark, with small admixture of mixed shades. Beard: growth, more than medium; form of hair, wavy. Head form: oval. Forehead: medium slanting. Supra-orbital crest: below medium. Face: oval, with strong horizontal profile. Nose: height of root above medium; strong horizontal profile; nasal profile straight or convex; cartilage straight; tip slightly elevated; nostrils slant medium, oval in cross section, medium alae, tip inclination slight. Lips thin. Ears mainly oval with more than average protrusion. Helix well-developed; lobe usually attached.

Head very narrow, long, high. Dolichocephalic. Orthocephalic narrow forehead. Medium face length. Small zygomatic and bigonial breadths. Leptoprosopic. Nose medium long, medium broad. Leptorhine. Majority of individuals clearly Europeanoid.

Chaudyrs of Khwarazm.—Stature: above average. Hair and eyes: dark. Beard: growth below medium. Head: oval but higher admixture of spheroidal and sphenoidal forms than among the Iomuds. Forehead: medium slanting. Supraorbital crest: below medium. Face: oval, but with definite admixture of pentagonoidal forms. Nose: root height below medium; horizontal profile medium; profile straight or convex; cartilage, straight or concave; tip slightly elevated; slant of nostrils, medium. Epicanthic fold: relatively frequent (20 per-

⁸⁹ I Arkho, A. I., *Turkmeny Khorezma i Severnogo Kavkaza*. AZH, Nos. 1-2, pp. 70-119, 1933.

cent). Upper eye fold: weak. Upper lip: height above medium; thin, but thicker than that of Iomuds. Ear: more protruding than that of Iomuds; less pendulous lobe. Compared to Iomuds, Chaudyrs have less dolichocephaly, greater head breadth and less head height. They also have wider minimum frontal, zygomatic, and bigonial diameters and greater face height. The Chaudyrs have a large admixture of Mongoloid individuals.

Chaudyrs of the Caucasus.—This group is still farther removed from the Iomuds. Stature: lower. Hair: darker. Beard: growth weaker. Forehead: medium slanting, supraorbital crest. Facial profile: much weaker. Nose: root height below medium; tip elevation straight. The remaining characteristics do not show a sharp deviation from other groups. Mongoloid peculiarities of the eye are like those of Khwarazm Chaudyrs, but epicanthic fold less frequent. Great upper lip height. Ear: lower percentage of pear-shaped forms; greater ear protrusion; smaller degree of helix inversion. Still less head length, but greater head breadth than Iomuds. Mesocephalic index. Broader minimum frontal, zygomatic, and bigonial diameters. Greater nose length and breadth than the Iomuds. Very considerable percentage of individuals of Mongoloid type.

Certain group distinctions are observable among Caucasian Turkomans, the most significant being the lesser Mongolization of the Chaudyr subgroup in comparison with Suim-Dzjadzhii and the Ygdyr.

Summary.—Our problem is to discover which of the three Mongol races of Northern and Central Asia participated in the formation of the Turkoman racial type: North Asiatic, Central Asiatic, or South Siberian.

It must be stated that our materials do not furnish a definite answer to this problem. Obviously the probability of participation of the North Asiatic⁹⁰ element is small. Since the greatest degree of Mongoloidicity among the Caucasian Turkomans is accompanied by a bizygomatic breadth of 145-146 mm., the possibility of a considerable admixture of the Ural-Altai subtype is excluded.

The participation of the Paleo-Siberian type (subdolichocephalic, massive, broad-faced, with strongly slanting forehead and a sharply marked supraorbital crest) is impossible to deny since geographically it had been in contact with the long-headed race both in Siberia and Europe. If such were the case, its traces may more probably be found in the Caucasus than in Khwarazm, and other Mongoloid ele-

⁹⁰ Cf. the Ural-Altai group including the Voguls and Shortsi.

ments must have taken part in the Turkoman admixture. The first is seen from the similar development of browridges and the inclination of the forehead of the Iomuds and of the Khwarazmian Chaudyrs. A Paleo-Siberian admixture among the Chaudyrs would have been expressed in a greater inclination of the forehead in comparison with the Iomuds. The browridges of Caucasian Chaudyrs are strongly expressed and do not contradict the possibility of the presence of a Paleo-Siberian complex.

On the other hand, this possibility is denied by the slight inclination of the forehead. The differences in type between the Caucasian and Khwarazmian Chaudyrs suggest, more or less definitely, the heterogeneous character of the Mongoloid components. Historical data indicate contacts of Turkomans and their ancestors, the Guzes, on one side, with other peoples of Turko-Mongol origin, on the other. Among these must first be mentioned the Kazakhs, Kalmyks (in the case of the Caucasian Turkomans) and the "historical Mongoloids" of Central Asia. Accordingly, it would be appropriate to discover the relative degree of participation in the formation of the physical type of the Turkomans of the Central Asian brachycephals, particularly since the great brachycephaly of the Mongol element among the Turkomans is proved through an ordinary comparison of group means.

The Khwarazm Chaudyrs, having in comparison with the Caucasian Chaudyrs a greater admixture of the Europeoidal type, are nevertheless characterized by a similar height of the nose, a greater percentage with an epicanthic fold, a similar degree of upper eye fold, and heavier browridges.

To summarize, the Central Asian type is without doubt represented among both the Caucasian and the Khwarazmian groups; to a certain degree, the possibility of participation of the South Siberian type is stronger in the Caucasus. The differences of the isolated types tend in three directions: toward the Kazakhs (South Siberian type); toward Tannu-Tuvans (Central Asiatic type); and, in the case of the Iomud group, toward the Mediterranean Europeoid complex.

To turn to another phase of the problem, let us examine the so-called Europeoidal complex. This should also show relationships to the already known type of Europeoids in Central Asia. The characteristic group, described by Oshanin and IArkho, was conditionally named the "Pamiro-Ferghanic." The distinctive traits of this group are: brachycephaly, more or less straight forehead, relatively dark pigmentation, and a moderately narrow face (138-142 mm.). However, among the Turkomans brachycephaly is connected with the Mongoloid, and not the Europeoid, complex. The Europeoid complex

of the Turkomans is dolichocephalic, having the smallest cephalic index (75.0) known in the U.S.S.R.

There are some historical data showing that the dolichocephaly of the Scytho-Sarmatian tribes, and also of the Turkomans, may have been caused by a peculiar local method of artificial cranial deformation, resulting in the change in the cephalic index. During the expedition E. G. Libman and D. Iomudskaia studied the use of the felt headgear put on the heads of the nursing babies and demonstrated that the use of such a hood could not result in a dolichocephalic change of the skull, and that the children were naturally dolichocephalic.

In applying the fact of negative interracial correlation of the head length and breadth discovered by Pearson and Czepurkowski to Central Asiatic groups, we find that some groups possessing great head length have, at the same time, a smaller head breadth. The Turkomans belong in the lower left-hand corner of the correlation grid, having the greatest length and the smallest breadth. In the upper right-hand corner belong the Uigurs. According to IArkho and Debets, the lack of positive correlation between the length and breadth of a group indicates its mixed character. In this connection two facts are of interest: (a) great positive correlation of Iomuds; and (b) impairment of correlation of Khwarazmian Chaudyrs. The first verifies the racial, and not artificial, character of the Turkoman dolichocephaly. The small size of the index excludes the possibility of significant participation of any Europeoid brachycephalic type. It is possible to claim that the Europeoid base of all investigated Turkomans is homogeneous. This is explained socially by strict endogamy, national, tribal, and clannish, of the Khwarazmian Turkomans. In the Caucasus the Turkomans mix with the Turkish Nogais, Europeoid Tatars, who apparently have a Europeoid element comparable to that of Turkomans. Formerly, they used to mix with Kazakhs and Kalmyks.

A STUDY OF THE TURKISH PEOPLES, 1924-1934

In a posthumous article,⁹¹ edited by G. Debets, A. I. IArkho⁹² published a summary of a systematic anthropometrical survey continued for 10 years among the Turkish peoples of the Soviet Union.

⁹¹ IArkho, A. I., *Kratkii obzor antropologicheskogo izucheniia Turetskikh narodnosti SSSR za 10 let (1924-1934)* [A brief review of the anthropological study of the Turkish peoples of the U.S.S.R. during the 10 years 1924-1934]. *AZH*, No. 1, pp. 47-64, 1936.

⁹² IArkho's death in Turkestan during 1935 came as a great shock to his colleagues throughout the world, since he was one of the foremost Soviet physical anthropologists. His work will be quoted in many text books still

The systematic anthropological study of Turkish peoples in the U.S.S.R. was begun in 1924, little having been done previously. The Academy of Sciences of the U.S.S.R. has sponsored the study of the following peoples:

1. Chuvashes, Uzbeks, by B. Vishnevskii.
2. Tatars of the Crimea, and Nogais of Daghestan, by N. Terebinskaia.
3. Yakuts, by Schreiber.
4. Kazakhs, Bashkirs, and Teptiars, by S. I. Rudenko and S. Baronov.
5. Kirghiz, by R. Mitusova.
6. The Central Asiatic organizations of the Academy sponsored the study of the Uzbeks, Kirghiz, Kazakhs, and Turkomans by L. V. Oshanin, in collaboration with V. K. IAsevich.
7. The physical development of children was recorded by Shishlov, Goncharov, and others; that of adults by A. I. IArkho, A. Askarov, and others; while demographic studies were made by D. Iomudskaia, E. Time, and assistants.
8. The following studies were also conducted:
 - a. Tatar tribes of European Russia, by G. Debets, T. Trofimova, and V. Sergeev, all of MGU.
 - b. Turkish tribes of the Caucasus, the Karachais, and Balkarians, by V. Levin and V. Bunak, both of MGU.
 - c. Kumyks and Kazakhs of the Volga area (Povolzhe) by G. Debets and T. Trofimova.
 - d. Azerbaidzhan Turks by Debets, IArkho, and N. I. Anserov.
 - e. Mountain Tatars of the Crimea by IA. Roginskii.
9. The former Society for the Study of the Urals, Siberia, and the Far East collected and preserved materials on the anthropology and demography of the Shortsi, Teleuts, nationalities of the Oirot Autonomous Province, Khakass (various groups), Kazakhs, Kirghiz of Kirghizia and Uzbekistan, Uigurs, Uzbeks (various groups), Kuramins, Kara-Kalpaks, Turkomans of Turkestan S.S.R. and of the North Caucasus, Azerbaidzhan Turks, Nogais of Daghestan (IArkho), Kumyks (A. Grinevich), Karaims (B. Adler), and the Russo-Turkish mestizos of the Altai and of the Khakass Autonomous Province. The craniological research was conducted by Bunak, Debets, and Trofimova.
10. A MGU Expedition (V. Bunak and A. I. IArkho, leaders) was dispatched to Tannu-Tuva [formerly Uriankhai].

unwritten. I had the privilege of meeting him at MGU in September 1934, and of discussing numerous anthropological problems of the Caucasus, Turkestan, and Central Asia. (H. F.)

11. Quantitatively, the materials assembled greatly exceed the pre-Revolutionary collections. For the first time the Kumandintsis, Altai-Kirghis, Teleuts, Crimean Tatars, Astrakhan Tatars, Kara-Kalpaks, Kirghiz, Uzbeks, Kuramins, Tubalars, and Shortsisis were investigated.

12. Among the few Siberian and Tatar groups still to be studied are the Karagasis, Kalmazhis, and Dolgans.

13. The study of the Turkish peoples was carried out in four fields:

- a. Racial composition.
- b. Physical development.
- c. Mestization.
- d. Demographic data.

Racial composition.—The theoretical problems of racial analysis of the Turkish nationalities have been studied mainly by Bunak (craniological data) and by Oshanin and IArkho. The majority of the data, particularly those collected by the MGU investigators (Debets, IArkho, and Trofimova), those of Central Asia (Oshanin) and of Transcaucasia (Anserov), yielded consistent results.

According to IArkho, it is already possible, through the study of the data available, to obtain a relatively accurate idea of the basic anthropological types which were combined to produce the modern Turkish peoples, although there still remain many unsolved problems.

In attempting to classify the Turks into one of the racial branches either in a Mongoloid or a Europeanoid⁹³ race of the first order, IArkho comes to the conclusion that the racial heterogeneity of the Turks has been entirely proved. If one disregards the more recent admixture of the Russian elements, some of the Altaic peoples of Siberia and the Yakuts may be considered to be relatively pure Mongoloids. The concentration of the Mongoloid influence decreases gradually toward the west. The western Turks are characterized by feebly expressed Mongoloid traits and by practically pure European characteristics, e.g., the Kumyks (Debets); Azerbaidzhan Turks of Nakhichevan, Nukha, and Gandzha (Anserov, IArkho, and Debets); Karaims (Adler); and the Crimean Tatars from the south coast (Terebinskaia).

A large section of the Turkish language groups is of a racially hybrid character. They are mixtures of varying composition of the Mongoloid and European races of the first order, e.g., Uzbeks, Tatars,

⁹³ Term used by Soviet anthropologists to denote *Homo sapiens indo-eurofacus* in contradistinction to *Homo sapiens asiaticus* (Mongoloid) and certain transitional forms such as *suburalis* and *sublappica* (sublaponoid). IArkho does not differentiate between Turks and merely Turkized stocks. (H. F.)

Bashkirs, etc. Many racial types of the second order entering into the composition of various Turkish peoples may be successfully discerned by different methods of racial analysis.

Three Mongoloid races of the second order were discovered by IArkho in the Altai-Saian highlands: Ural-Altai, South Siberian, and Central Asian.

Rudenko states that the Kirghiz and the Kazakhs belong to the Central Asian stock. They are characterized as possessing in general South Siberian traits, with a small admixture of the European Pamiro-Alpine element, which according to Trofimova becomes increasingly strong in the west.

In Central Asia, Oshanin and IArkho distinguished brachycephalic Pamiro-Alpine, dolichocephalic Mediterranean,⁹⁴ and "Vorderasiatische Armenoid" types.

In Transcaucasia the Armenoid influence is also found simultaneously with the Pamiro-Alpine and the Mediterranean elements (Anserov, IArkho, and Debets).

The admixture of Mongoloid traits, while extremely slight, may nonetheless be traced, as for example among the Azerbaidzhan Turks in Gandzha (IArkho) and the Mughal-Turks of Kakh (Debets).

In the North Caucasus, V. Levin has described a special "Japhetic"⁹⁵ element, observed also by Debets among the Kumyks. The Mongoloid elements were found to be concentrated among the Nogais and the Turkomans (Levin, Terebinskaia, and IArkho).

In the Crimea, Pamiro-Alpine and Dinaric elements were recorded by Terebinskaia among the Crimean Tatars.

Among the Tatars of the Middle Volga region (Debets and Trofimova), in addition to a slight Mongoloid admixture (the South Siberian variant), they were found to possess the Eurasian sublappoid component element described by Bunak and Zenkevich and also an admixture of the eastern Baltic and the northern types.

The same component elements were encountered among the Bashkirs with a far greater prominence of the Mongoloid type.

The unpublished materials on the Chuvash (Vishnevskii) disclose the presence of distinct traces of the suburalic type of Bunak.

On the basis of all available data it has been possible to discern

⁹⁴ The identification of a dolichocephalic Mediterranean element in Central Asia seems to me of great significance since, in addition to the Mediterranean belt which extends from Morocco to the Pacific Ocean, following a line south of the Himalayas, there must also have been connecting lines of migration into Central Asia. (H. F.)

⁹⁵ IArkho preferred the term "Caucasian proper."

not less than three Mongoloid races of the second order, six Euro-peoid races, and one or two transitional types. IArkho suggested immediate standardization of these definitions. Wherever craniometric studies were possible, the results conformed to a remarkable degree with those obtained on the living.

Provisionally, the zone of the original formation of Turkish languages appears to have been peopled by both Mongoloids and dolichocephalic Europeans.

On the basis of existing data, the modern Turks may be considered neither as belonging to a homogeneous race, nor as originating from a single racial base. This does not contradict the results obtained by Oshanin and IArkho, substantiated by the paleoanthropological finds of Debets, showing the contemporaneity of Mongoloid complexes with definite historical groupings and stratifications of the Turks in Central Asia and South Russia (e.g., the Polovtsy) as well as the connection found by Debets between the ancient Turkish elements in the Chuvash language with the sublappoid and Mediterranean European elements.

Physical development.—A regional characterization is complicated by the lack of data⁹⁶ and the differences in recording techniques. It is possible, however, to state that the physical development of the Turkish tribes varies greatly with the geographic, economic, and social conditions, all of which have operated for long periods of time to modify the somatic peculiarities of the inhabitants.

It often happens that racially different groups in a closely similar environment retain their own peculiar traits, as, for example, the narrow chests of the Turkomans (Oshanin), while closely related groups under differing environments show different physical indices.

Among the Chuvashes, Kirghiz, Uzbeks (Libman), and the Turkomans of North Caucasus (Vertogradskaia), body temperature, rate of pulse and respiration, and blood pressure were recorded.

No specific racial peculiarities were disclosed through the study of blood samples, many of which were collected.

Mestization.—Because of the highly mixed character of the Turkish peoples with regard to the races of the first and second orders, it is possible to utilize the data regarding such tribes for the study of the problems of mestization.

A special study was undertaken by IArkho during 1924-1925 in the Oïrot and Khakass Autonomous Provinces. Because of the

⁹⁶ Records of stature, weight, chest circumference, etc., were taken by members of the former Society for the Study of Soviet Asia and MGU. These figures are given in table 7, AZH, No. 1, pp. 47-64, 1936.

insufficiently developed program and the errors of method, the results are not valid. Nevertheless, the materials collected testify to the absence of any negative influence of mestization upon the physical development of the population. The hybrids of Altaians and Khakass with the Russians have the higher physical indices of the Russians (Belkins and IArkho).

Data regarding the physical development of definitely hybrid groups (e.g., Uzbeks, Kara-Kalpaks, etc.) demonstrate conclusively that no decrease of anthropometric indices accompanies mestization.

No materials have yet been published regarding the mechanism of variability of racial traits in the course of mestization.

Demographic data.—The demographic study of the Turkish peoples was conducted by questioning individual families and economic units.

The following areas were studied under different auspices: The UNKHU Expedition, the Society for the Study of Soviet Asia, and the Uzbek Institute of Social Hygiene in the Oirot Autonomous Province, the Kirghiz S.S.R., Uzbek S.S.R., the Kara-Kalpak A.P., the North Caucasus, the Bashkir A.S.S.R., the Karachev A.P., and in Daghestan; the Institute of Social Hygiene of the R.S.F.S.R. and the Society for the Study of Soviet Asia in Daghestan; and by the latter and the Turkoman Institute for Social Hygiene in the Kara-Kalpak A.P., and the Tatar A.S.S.R.; and the Academy of Sciences of the U.S.S.R. in the Bashkir, Kazakhstan, and the Yakut A.S.S.R. In addition, the current official statistical data of the GOSSTATISTIKA were available.

Although the theoretical interpretation of these data is under consideration by Time, Schreiber, and Baronov, the following facts may now be stated:

a. The presence of a specific demographic structure (age-sex composition) of many Turkish groups.

b. Relatively high dynamic indices of many groups.

c. Many radical demographic changes, with respect to the longevity, mortality, marrying age, etc., as a result of improvements in social-economic conditions.

d. That the peculiarities noted can in no sense be connected with the racial factors, in so far as the inheritable influences of fertility and other biodemographic indices are governed by the social-economic factors.

e. That the gradual numerical decrease of two Turkish peoples, the Nogais and the Turkomans of North Caucasus, can be explained by social-economic analysis (IArkho).

f. At the end of the First Five Year Plan the following were the

unfavorable factors: Early marriages of women resulting in lowered fertility, high infant and female mortality, lower longevity (in comparison with Russians) and general higher mortality of Nogais, Karakalpakhs, Kirghiz, Turkomans, and others. These were doubtless due to the former low level of social-economic relations, servile status of women, etc., and are now showing signs of disappearing (IArkho).

The important tables⁹⁷ of anthropometric data have been omitted since the physical anthropologist can have ready access to them should he so desire.

PALEOANTHROPOLOGY OF THE LOWER VOLGA AREA

In 1930 G. F. Debets⁹⁸ measured ancient skeletal remains from various Volga sites preserved in the Museum of the Kuibyshev [formerly Samara] Society of Archaeology, History and Ethnography, the Regional Museum of Saratov, and in the Central Museum of the Volga-German A.S.S.R. at Engels.

The earliest well-known sites from this area, characterized by a microlithic industry, belong to a later period than the western stations yielding geometric forms. Usually associated with these microliths is pottery of the same type as the Eneolithic sites of the Drevne-Iannaia culture.⁹⁹

The burials contain flexed, stained skeletons, egg-shaped pottery, and isolated flint, or, rarely, copper implements. This period is characterized by the prevalence of hunting and fishing with a slight development of animal domestication toward the end of the period and a total absence of agriculture.

According to Debets the crania were not Mongoloid in spite of the great facial breadth. On the basis of the typical combination of a low, orthognathous face with low orbits and a highly prominent nose, Debets considers them to be definitely European. The great percentage of slanting foreheads with very strong browridges comparable

⁹⁷ Tables 1 to 4 include 20 measurements and observations on groups in Siberia, Central Asia, Caucasus, and Crimea, and the Volga area. The data, obtained during the past 15 years, are made available here in English for the first time. See AZH, No. 1, pp. 47-64, 1936.

⁹⁸ Debets, G. F., *Materialy po paleoantropologii SSSR: Nizhnee Povolzhe* [Materials for the paleoanthropology of the U.S.S.R.: Lower Volga area]. AZH, No. 1, pp. 65-81, 1936.

In September 1934 I met G. F. Debets at MGU, where he is the leading physical anthropologist of the younger generation. He has recorded considerable anthropometric data among widely scattered groups. His publications are already extremely valuable. (H. F.)

⁹⁹ "Culture of the Burying Grounds in Fosses."

to Australian crania or IArkho's "South Siberian" type is not represented among modern European races; the Lower Volga series in this respect may be compared only with the Upper Paleolithic series from Brünn (Brño) and Predmost in Moravia.

The "Catacomb Burial Period," succeeding the Drevne-IAnnaia culture, is characterized by a greater increase in animal domestication. These burials, almost never found on the left bank of the Volga, are probably a local form. Only four male crania of this period, from the Ust-Griaznukha excavations of T. Minaeva near Stalingrad, were studied. In general, they have both a greater cranial index and a greater height than the crania of the preceding period associated with a European facial structure.

Debets mentions that another more numerous group of brachycephalic crania from catacomb burials is known from the Slobodka-Romanovka tumulus near Odessa, described in 1915 by D. K. Tretiaikov, who states that "catacomb-building brachycephals are found as an alien element wedged among the predominantly dolichcephalic populations."

The second half of the Bronze Age in the Lower Volga area is known as "Srubno-Khvalynskaia"¹ after P. S. Rykov and V. V. Holmsten, or "Stage II of gens-society" after A. P. Kruglov and G. V. Podgaetskii. This culture is characterized by the leading role of agriculture and the use of domesticated animals.

The skeletal remains differ but slightly from those of the preceding period. The crania are characterized by straighter foreheads, smaller browridges, and a somewhat smaller bizygomatic breadth. There was no apparent connection between the slight change in morphological characters and local cultural variations so that there was no reason for supposing that the people of the Srubno-Khvalynskaia culture came from outside.

Only one female skull from the subsequent period, the so-called Scythian stage, was available to Debets. This in turn was followed by the Sarmatian culture (third century B. C.—third century A. D.).

Skeletal remains from 17 sites, excavated by Zhuravlev (1), P. D. Rau (11), and P. S. Rykov (5), were studied by Debets. In 1928 B. Grekov pointed out the similarity between the Volga and the Ural burials of the Hellenistic period. The later burials, attributed to the Roman period, are connected with the preceding phase by a series of minor transitions so that burials from both periods can be considered as belonging to one "Sarmatian" culture, characterized by pastoral nomadism.

¹ "Log-cabin type of burial culture."

No anthropometric differences could be observed between Hellenistic and Roman crania. Regionally, however, significant differences were found between crania from the Volga-German region and the Astrakhan district. The crania from the former were mesocephalic and large; from the latter they were brachycephalic and small. While the general European character of the face is common to the two periods, the skull differs greatly in breadth and in other characteristics.

Bronze Age dolichocephalic crania were encountered at a much later period in the Finnish burial grounds of the Middle Volga. This agrees with the archeological data, which indicate a direct continuity between the two cultures. The same type of cranium is present in the "Andronovo" culture burials from the Minusinsk region of western Siberia. The Sarmatian crania stand much closer to the Andronovo crania than to those of the Volga Bronze Age. The same type of cranium was found by M. N. Komarova in burials along the left tributaries of the Ural River in Kazakhstan.

The brachycephalic Sarmatian crania from the Astrakhan district differ greatly from those of the Volga Bronze Age. The combination of brachycephaly with the slanting forehead is nearer to the Mongoloid Turkish type on one side, and to the Armenoid skull on the other. Because of the low facial height and the highly prominent nose, Debets classified these Sarmatian crania as European; not having sufficient data to compare them with the proper Armenoid type, he places them in the Eurasian brachycephalic group, the Pamiro-Alpine. The Sarmatian brachycephalic crania are also comparable to the round-headed type of the Catacomb culture, both belonging among Eurasian brachycephals.

No analysis was possible on the fourth-fifth century Sarmatian crania, because of the widespread practice of artificial cranial deformation. Only one late Sarmatian skull, attributed to the seventh-eighth centuries A. D., was available to Debets. This was of Mongoloid type with a very high face and a tendency toward dolichocephaly. It is impossible to state, on the basis of this single specimen, whether the length of the skull was typical for the given group, as it is known that the dolichocephalic Mongoloids of the Paleo-Siberian type were known to penetrate into Europe, or whether it was an individual variant or a case of mestization with some European stock.

During the first half of the present millennium, the Mongoloid South Siberian type appears in great numbers near the Lower Volga region, in an almost pure form among the nomads and continuing its existence among the population of the settlements of the Golden Horde.

Debets gives the following conclusions:

1. The oldest type is represented by the skeletons of the so-called Drevne-IAnnaia culture, attributed to the third millennium B. C. This type is closely similar to the Upper Paleolithic crania of Western Europe.

2. The stage of the Catacomb culture, which apparently did not spread east of the Volga, belongs to the end of the third and to the beginning of the second millennium B. C. This culture appears to have penetrated from the west. The typical skull, belonging to the Eurasian brachycephals, stands most closely to the Dinaric group. To some degree, this type is also connected with a similar culture in the Ukraine.

3. The Srubno-Khvalynskaia culture of the late Bronze Age (second millennium B. C.) in many localities follows directly after the Drevne-IAnnaia culture; in general, the racial type is close to that of the preceding period.

4. Crania of the period between the end of the Bronze Age (ninth century B. C.) and the beginning of the Hellenistic period (third century B. C.) have not been studied.

5. The prevalent racial type of the Sarmatian culture, during the Hellenistic and the Roman periods (third century B. C.—third century A. D.) came to the Volga area from Kazakhstan; the crania and long bones appear to be most closely related to the skeletons of the Andronovo culture from western Siberia.

6. During the same period there is also found, mainly in the Astrakhan area, a type belonging to the Eurasian brachycephals, which may be connected with the type belonging to the Catacomb culture.

CRANIOLOGY OF THE TATARS OF THE GOLDEN HORDE

Trofimova² of the Moscow State Museum of Anthropology studied a series of 35 male crania from two sites of the Golden Horde period (fourteenth-fifteenth centuries) at Sharinnyi Bugor [hill] and Streletskaiia Sloboda settlement, near Astrakhan. These crania, originating from Vorobiev's and Lesgaft's excavations about 1870 are now preserved in the Moscow State Museum of Anthropology and in the Museum of the Anatomical Institute, Kazan. The series of 11 crania from the Kazan Museum were measured by Debets, the rest by Trofimova. Rudolph Martin's measurements were used by Trofimova,

² Trofimova, T. A., *Kraniologicheskii ocherk Tatar Zolotoi Ordy* [Craniological outline of the Tatars of the Golden Horde]. AZH, No. 2, pp. 166-192, 1936.

and the range of variation for means as suggested by Bunak was followed.

This series was brachycephalic (greatest occipital length 176.9; greatest breadth 145.4), hypsicephalic (height 132.9), and of medium size, with a medium broad forehead. The skull was often sphenoidal, although spheroidal and euripentagonoidal forms predominated. The face was of medium height and breadth; the nose was medium broad and the orbits of medium height. The slant of the forehead was medium, the profile orthognathous, with a medium nasal prominence.

In attempting to discover the racial affinities of the series, Trofimova deduced that the facial characteristics were close to the European Armenian (Bunak's 105 crania) Abkhazian (Trofimova's 41 crania) and eight "Sarmatians" from Astrakhan (Debets). The Tatar crania, however, had a less prominent nose and a less-developed fossa canina, and a relatively large number (28.5 percent) had a fossa prenasalis type of nasal orifice. No other Mongoloid traits were present.

In general, the series was considered to belong within the Europeoidal brachycephalic groups, despite the presence of Mongoloid elements. After examining 24 crania in Moscow Trofimova divided them into two groups, one showing preponderance of Europeoidal traits, the other having Mongoloid tendencies. Of the seven crania classified as Mongoloid, only two were definitely of Mongoloid type; the others having only certain Mongoloid traits. Several crania of the European group were of the characteristic European type, the remainder manifesting a slight Mongoloid admixture.

The cephalic index of the Europeoid group is less than that of the Mongoloid, while the absolute dimensions of the Mongoloid group are greater, and the skulls higher. The crania of the Central Asiatic and the South Siberian types, which may have participated in the formation of this Tatar group, are also of large absolute dimensions and relatively low height. On the basis of further analysis, Trofimova came to the conclusion that the Golden Horde Tatars from Strel'tskaia Sloboda and Sharinnyi Bugor were a mestized group consisting, basically, of the brachycephalic European and the Mongoloid types.

In order to determine the component elements of the Golden Horde Tatars, Trofimova compared them with other brachycephalic crania of mixed types. For this reason she examined a series of 14 Uzbek crania from contemporaneous cemeteries of Zolotaia Mulushka near Samarkand and from Tashkent. Trofimova also examined a series of 41 Abkhazian crania (37 of which had been described in 1879 by

3. Uvek site: South Siberian type; partly Pamiro-Ferghan, or a closely related variety of European brachycephalic type.

4. Bukcevskaia steppe: Pamiro-Ferghan of a closely related Euro-peoidal brachycephalic type with probable Mediterranean admixture.

5. Tiaginka village, near Kherson on the Dnieper: South Siberian.

Trofimova then gives a summary of the pre-Mongol populations of the Lower Volga:

Earliest known remains are Sarmatian described by P. S. Rykov and P. D. Rau. Previously considered to be Iranian nomads from Asia, who began their invasion during the fourth century B. C., the Sarmatians, according to Marr, Ravdonikas, etc., "were not an ethnic group, but rather a new stage in the development of society during the Scythian epoch," in the regions of the Black Sea steppes (Sauro-matians) and the Volga. The Sarmatian crania described by Debets³ are of a brachycephalic type with a medium high face, leptorrhine and wide prominent nose, definitely European, in spite of the rather great face breadth. Similar crania were described by Rudenko⁴ from Prokhorovo tumuli near Orenburg, and by Komarova⁵ from Bronze Age sites.

Trofimova also examined seven crania from Chilpek burial ground near Kara-kol in the Kirghiz A.S.S.R. excavated in 1929 by M. V. Voevodskii and attributed to the period between the first century B. C. and the first century A. D. They were compared by Voevodskii with the "Scythian" crania from Altai, described by Griaznov,⁶ and also with the nomadic burials from Orenburg steppe excavated by Grekov. Trofimova found that six of the crania belonged to IArkho's Pamiro-Ferghan type now living in Central Asia; one was close to the Medi-terranean type; one, while similar to the Pamiro-Ferghan type, possessed an Armenoid nose and a few similarities with the Medi-terranean type.

The second series attributed to the Sarmatian period, described by Debets from the Volga-German A.S.S.R., was of the so-called Andronovo type.

³ Debets, G., *AZH*, No. 1, 1936.

⁴ Rudenko, S. I., *Opisanie skeletov iz Prokhorovskikh Kurganov* [Description of skeletons from Prokhorovo tumuli]. *Materialy Arkheologii Rossii*, No. 37, 1938.

⁵ Komarova, M. N., *Cherepa bronzovoi epokhi iz mogil po levym pritokam reki Ural* [Bronze Age crania from the graves on the left tributaries of the Ural River], Leningrad, 1927.

⁶ Griaznov, M. P., *Raskopka kniazheskoi mogily na Altae* [The excavation of a prince's tomb in the Altai]; *Pazyrykskoe kniazheskoe pogrebenie na Altae* [A prince's burial from Pazyryk, Altai]. *Priroda*, No. 11, p. 971, 1929.

When these Sarmatian crania were compared with the European group of the Golden Horde Tatars, one thousand years later, Trofimova discovered an exceptional degree of similarity between them. This agrees with the archeological evidence collected by Rykov, who concludes that the culture of the Sarmatian epoch "grew over into" the Golden Horde culture in the Lower Volga.

This brachycephalic type is still preserved in Central Asia among modern inhabitants of Uzbekistan and Tadzhikistan.

According to Debets, the dolichocephalic European type, widespread in the steppes of the Ukraine during the Scytho-Sarmatian ⁷ period, is also represented in the Saltovo burials of the eighth and ninth centuries, variously classified as "Alanic" or "Khozarian"; ⁸ another type, present in Saltovo, were brachycephalic European crania of Dinaric affinities. It was curious that no Mongoloid crania were found in this series of "Tatar" burials.

The only Mongoloid South Siberian crania attributed to the Torks (?) were found in Gorodtsov's excavations in the Izium and Bakhmut regions of the Ukraine. These crania were attributed to the eleventh century A. D. Debets, who studied this series of 15 crania, stated that there were 3 European dolichocephalic crania and 4 of the mixed type.

The only other Mongoloid crania from eastern Europe from any period are the fourth century A. D. Hun crania from Hungary described by Bartucz.⁹

CONCLUSIONS

The Golden Horde Tatars were a strongly mestized group composed of Europeoid and Mongoloid elements. The city-dwellers' crania from Sharinnyi Hill and Streletskaia Sloboda, as well as those from Uvek belong mainly to the Pamiro-Ferghan European type. The Mongoloid element present in the series belongs overwhelmingly to the South Siberian (Deniker's "Turkish") type. The latter is typical for the Golden Horde nomad crania from sites in the Pugachev region and from the Volga-German A.S.S.R., where there appears a European admixture.

⁷ Bogdanov, A. P., *O mogilakh skifo sarmatskoi epokhi i o kranologii skifov* [The tombs of the Scythio-Sarmatian epoch and Scythian craniology]. *Antropologicheskaja vystavka*, vol. 3, pt. 1, p. 263.

⁸ Debets, G., *Cherepa iz Verkhne-Saltovskogo mogilnika* [Crania from the Upper Saltovo burial ground]. *Antropologiya, VUAN* [now ANU], vol. 4, Kiev, 1931.

⁹ Bartucz, Lajos, *Über die anthropologischen Ergebnisse der Ausgrabungen von Moson Szent Janos*. *SKYTHIKA*, vol. 2, Prague, 1929.

The European brachycephalic type of the Lower Volga, of the foothills of the Urals ("PriUral'e"), western Kazakhstan, and Central Asia represents the ancient population of these regions during the Sarmatian epoch. This type was preserved during the Golden Horde epoch mainly among the city-dwelling Tatars but still exists among the Karagash Tatars¹⁰ of the Lower Volga region and among various groups of Central Asia.¹¹ It is also probable that IArkho's Pamiro-Ferghan type represented among the contemporary Kazakhs¹² of the Altai is also a vestige of this ancient population.

In the light of these materials¹³ it is possible once more to deduce that the Mongolian conquest may by no means be regarded as a significant mass migration, but as merely a military and political expansion of the Mongolian Empire. According to Barthold¹⁴: "The overwhelming majority of the Mongols returned to Mongolia; the Mongolians who remained in the conquered land, rapidly lost their nationality."

At the time of the partition of the Empire of Genghis Khan among his heirs, the majority of the Mongolian warriors remained in the Ugedei *Ulus* (Mongolia proper) and only 4,000 warriors remained in the entire territory of Djuchi *Ulus* including eastern Europe and the modern territory of Kazakhstan and Khwarazm. Thus, the numerous Mongol troops, mentioned by Plano-Carpini, most probably consisted of subjugated Kipchaks and other eastern European nomadic tribes. According to Barthold,¹⁵ "The formation of the Mongolian Empire was not accompanied, as in the instance of the German invasion of the Roman provinces, by the migration of the people."

In the light of the anthropological data it is interesting to note the

¹⁰ Based on T. Trofimova's unpublished data obtained during an MGU Expedition in 1932.

¹¹ Oshanin, L. V., *K sravnitelnoi antropologii etnicheskikh grup prishlykh iz Perednei Azii* [Contribution to the comparative anthropology of ethnic groups originating in Western Asia]. *Materialy antropologii naseleniia Uzbekistana*, No. 1, Tashkent, 1929.

¹² IArkho, A. I., *Kazaki Russkogo Altaia* [The Kazakhs of the Russian Altai]. *Severnaia Azia*, Nos. 1/2, p. 76, 1930.

¹³ Iakubovskii, A., *Stolitsa Zolotoi Ordy Sarai Berke* [The capital of the Golden Horde Saiai Berke]. GAIMK, Leningrad, 1932.

¹⁴ Barthold, V. V., *Istoriia turetsko-monogolskikh narodov* [History of the Turko-Mongolian peoples], p. 17, Tashkent, 1928.

¹⁵ Barthold, V. V., *Isotoriia kulturnoi zhizni Turkestana* [The cultural history of Turkestan]. Acad. Sci. U.S.S.R., Leningrad, 1927, p. 86.

contemporaneous evidence of the Arabic author Al Umari,¹⁶ who wrote in the beginning of the fourteenth century:

In antiquity this state [the Golden Horde] was the land of the Kipchaks [Polovtsy] but when it was conquered by Tatars, the Kipchaks became their subjects. Afterward they [the Tatars] mingled and intermarried with them [the Kipchaks] and the land prevailed upon their [the Tatars'] natural and racial qualities, and they all became even as like the Kipchaks as if they were of the same clan; for the Mongols [Tatars] had settled in the land of the Kipchaks, intermarried with them, and remained to dwell in their land.

The Mongoloid population of the Golden Horde also had its origin during the pre-Mongolian period. Thus the presence of South Siberian and European types, among the Tork subjects of Kiev, and the same types in Sarkel¹⁷ permitted Trofimova to connect the infiltration of these tribes onto the Caspian-Black Sea steppes with the epoch of formation of the Pechenegs, and later the Polovetsian (Kipchakian) feudal-clan unions in Kazakhstan and the eastern European steppes.

The complete absence of the typical Central Asian racial types among the populations of the Golden Horde, with the possible exception of Mongoloid admixture in the case of the Sharinnyi Hill crania, adds probability to this supposition.

Trofimova concludes that the Mongolian conquest, in the course of which there was formed the new political federation of the Golden Horde, and which exercised an enormous political and social-economic influence upon the conquered areas, apparently did not greatly change their racial and ethnical composition. The isolated dolichocephalic European elements discovered in the series of the city-dwellers' crania from Sharinnyi Hill may belong to either the pre-Mongolian period, or to the Khazar state with its mixed population.

CRANIOLOGY OF THE KALMYKS

Levin and Trofimova¹⁸ state that the earliest descriptions of single Kalmyk crania were published in the middle of the eighteenth century by Fischer, Kamper, and Blumenbakh. A complete bibliography of

¹⁶ This is quoted from V. Tizengauzen (W. Tiesenhausen), *Sbornik materialov otносиashchikhsia k istorii Zolotoi Ordy* [Collection of materials for the history of the Golden Horde], vol. 1, p. 325. St. Petersburg, 1884.

¹⁷ Debets, G. F., *Chelovecheskie kostiaki iz pogrebenii v Sarkel* [Human skeletons from the Sarkel burials]. [In ms.]

¹⁸ Levin, M. G., and Trofimova, T. A., *Kalmyki: kраниologicheskii ocherk* [A craniological description of the Kalmyks]. AZH, No. 1, pp. 73-81, 1937. [English summary.]

Kalmyk craniology was published by A. A. Ivanovskii,¹⁹ who also described a large series of crania.

Studies on Kalmyk craniology have been published recently by M. Reicher²⁰ and N. K. Lyzenkov,²¹ but these investigations were either published as comparative materials (Reicher) or were based on an insufficient amount of material (Lyzenkov: 5 male crania.)

The present investigation by Levin and Trofimova is based on a series of 61 crania in the Museum of Anthropology of Moscow First University.

A large portion of the series is described for the first time; there are 21 male and 9 female crania from the Kalmyk cemetery near Bodek settlement in the Manych area, which were brought to the Museum in 1925 by members of the Kalmyk Expedition from the State Institute for Social Hygiene. The remainder, already described by Ivanovskii and Reicher, come from the older collections of the Museum (11 crania collected by Lesgaft from cemeteries of Astrakhan, *Ulus* [nomad community] Khoshutovskii, and Zamianskaia Cossack settlement; and 20 crania collected by Walter and others).

The series of 61 contains 43 male and 18 female crania. The measurements and descriptions used are those of Rudolph Martin; the sex was determined cranioscopically. The three series were studied separately and collectively.

The Kalmyk type is described (pp. 76-77) in the following terms: Of medium length and relatively great breadth; brachycephalic, bordering on mesocephalic; the head not high; the face long and broad with a medium facial index; orthognathous; the nose long and not very prominent with a medium nasal index; the orbits high; and the forehead medium slanting. The browridges, fossa canina, and spina spinalis are weakly developed.

In general, the series might be regarded as Mongoloid, only seven skulls having some Europeoid traits (two from Manych, two collected by Walter, two Astrakhan). In attempting to analyze this Europeoid element, the author dismisses the possibility of a Russian admixture and agrees with the conclusions of Cheboksarov,²² who

¹⁹ Mongoly-Turguty Trudy Antropologich. Otd. IOLEAE, vol. 13, 1893.

²⁰ Untersuchungen über Schädelform der alpenländischen und mongolischen Brachycephalen. Zeitschr. Morphol. und Anthrop., vol. 15, No. 3, pp. 421-562; vol. 16, No. 1, pp. 1-64, 1913.

²¹ Materialy k kranologii Kalmykov [Craniology of the Kalmyks]. AZH, Nos. 1-2, 1933.

²² Cheboksarov, N. N., Kalmyki Zapadnogo ulusa [The Kalmyks of the western *Ulus* (subdivision of a horde)]. AZH, No. 1, 1935.

classified the Europeoid element among his group of western Kalmyks as being of the western Caucasian mesocephalic type ["Pontic race" after Bunak²³].

A series of Torgut skulls from Jugar investigated earlier by Reicher were reexamined by Levin and Trofimova. Although the Torguts were the principal component of the Kalmyks in the seventeenth and eighteenth centuries, no traces of Europeoid admixture were discovered. From this the authors conclude that Europeoid elements were absent in the composition of the Central Asian immigrants into the Volga region, who formed the chief component element of the Kalmyk people.

Thus, the authors conclude that the Kalmyks acquired these Europeoid elements after their emigration and during the subsequent periods of formation of the Kalmyk feudal union on the territory of the Lower Volga and the North Caucasus. The "Pontic" elements in this area are found since the Scytho-Sarmatian period,²⁴ later being present among the Tatars of the Golden Horde²⁵ and among the modern Nogais,²⁶ who were close neighbors of the Kalmyks.

The same Europeoid admixture is also found among the western Circassians.²⁷ There is also some trustworthy historical testimony regarding intermarriage between the Kalmyks and the Adighe. Thus, historical and anthropological data agree.

According to Palmov,²⁸ Shcheglov,²⁹ IArkho,³⁰ and Cheboksarov, the Kalmyk racial type was strongly affected by intermixture with the Turkomans [of North Caucasus].

Levin and Trofimova examined IArkho's conclusions identifying the Europeoid element among the Turkomans of the Mangyshlak Peninsula with a dolichocephalic element present in its purest form among the Iomud Turkomans of Central Asia. They came to the con-

²³ Bunak, V. V., *Crania Armenica*. Moscow, 1927.

²⁴ Debets, G., *Materials for the paleoanthropology of the Lower Volga*. AZH, No. 1, 1936.

²⁵ Trofimova, T. A., *Craniological description of the Golden Horde Tatars*. AZH, No. 2, 1936.

²⁶ Molkov, A. V., *Kalmyki* [Kalmyks]. Moscow, 1928.

²⁷ Levin, V. I., *Ethnogeographical distribution of certain racial traits amongst the populations of North Caucasus*. AZH, No. 2, 1932.

²⁸ Palmov, N. N., *Studies in the history of Volga Kalmyks*. 4 vols. Astrakhan, 1926-1929.

²⁹ Shcheglov, I. A., *Turkomans and Nogais in the Government of Stavropol*. Stavropol, ISID.

³⁰ IArkho, A. I., *Turkomans of Khoresm [Khwarazm] and North Caucasus*. AZH, Nos. 1-2, 1933.

clusion that this Europeoid element was closer to Bunak's "Pontic" type than to the more dolichocephalic, narrower-faced Central Asian Europeoid type.

The interrelation between the mesocephalic ("Pontic") and the dolichocephalic variants of the eastern branch of the Mediterranean race have not yet been determined. IArkho suggested a connection between the dolichocephalic Turkoman groups and such dolichocephalic Caucasian groups as the Kurds and Azerbaidzhan Turks, without, however, making an analysis of the relationships. Although Cheboksarov differentiated between the mesocephalic component of the western Circassians and the extremely dolichocephalic type common among the Iomud Turkomans, yet he followed IArkho in seeking only the latter element among the Turkomans of North Caucasus. This does not explain the absence of the dolichocephalic type among the Kalmyks, who were fixed with the Turkomans.

After comparing the Mongoloid elements with other Mongoloid groups, Levin and Trofimova arrived at the following conclusions:

The average for the series agreed with the measurements of Tannu-Tuvans from Kemchik, measured by Debets:³¹ the Kalmyks possessed more slanting foreheads, higher orbits, and slightly more prominent, but narrower, noses. These characters are similar to those of Buriats from Kudinsk, measured by Debets (*loc. cit.*), and are generally common for the South Siberian types (e.g., the Kazakhs) who, however, are extremely brachycephalic and have very large absolute cranial dimensions. A similarly strong frontal slant was also found by Roginskii³² among the Lake Baikal Tungus, who are, however, extremely dolichocephalic and have flat noses.

On individual evaluation of the crania in the Mongoloid portion of the series, a group of four aberrant crania was isolated (three from Manych, one from Lesgaft's collection from Zamianskaia). These four crania are dolichocephalic, with very high and wide faces, strongly slanting foreheads, and medium-prominent (for a Mongoloid group) noses. Without any doubt these four crania belong to the Paleosiberian race represented among the Tungus of Lake Baikal, the Ostiaks, the Voguls, and the Shortsi.

In the absolute dimensions of the skull and the facial and frontal characters, the Kalmyks are close to the Tungus. In the majority

³¹ Debets, G., Craniological description of Tannu-Tuvans. *Severnaia Aziia*, Nos. 5-6, 1929.

³² Roginskii, I.A., Materials for the anthropology of Tungus of the northern Lake Baikal area. *AZH*, No. 3, 1934.

of the relative dimensions of the skull and in the orbital and nasal measurements the Kalmyks are close to the Voguls.

Thus the Mongoloid components of the series are limited to the Central Asiatic and the Paleosiberian, in the larger sense of the word. These differ from Cheboksarov's series in the presence of the latter [Paleosiberian] and in the absence of the South Siberian type. This difference may be explained by geographic reasons, since the author's data are limited to the central portion of the area inhabited by the Kalmyks, while Cheboksarov studied the populations of the western regions, where the Kalmyks were strongly mixed with the Nogais among whom the South Siberian type is strongly represented (cf. Trofimova, 1936).

The presence of the dolichocephalic Mongoloid element, discovered by the authors, may be explained historically. The territory of the formation of the Oirot feudal union in ancient times formed part of the Great Hun State.³³ One of the craniological types of the Huns described by Bartucz³⁴ was found by Roginskii to be very close to the Paleosiberian type. The relations of the Oirot Union in the later period with the more northerly regions could also account for the introduction of the Paleosiberian type among the Kalmyks.

THE ULCHI (NANI) CRANIAL TYPE

Levin³⁵ of the Institute of Anthropology, Moscow University, examined 16 male and 11 female crania from Ulchi burials near Ukta, Mongoli, Dudi, and Kolchom settlements in the Amur region. These crania, presented to the Museum in 1936 by A. M. Zolotarev, form the only collection from this area. Golds, Udekhe, Oraks, Negidals, and Amur Giliaks are nowhere represented in Soviet Museums. The crania were mesocephalic, being short, narrow, and of medium height. They had medium slanting foreheads, with weakly developed frontal bosses. The frontoparietal index was low. The occiput of the majority of the crania was angular.

The face was high and medium broad, with an index of 55.7. The nose was high and medium broad, with a mesorrhine index. The glabella was low. The orbits were high and medium broad, the intra-

³³ Iakin, Historical survey of the Oirots or Kalmyks from the fifteenth century until the present time. Journal of the Ministry of the Interior (Russia), vol. 8, pt. 1, p. 33.

³⁴ Bartucz, Lajos, Über die anthropologischen Ergebnisse der Ausgrabungen von Moson Szent Janos. SKYTHIKA, vol. 2, Prague, 1929.

³⁵ Levin, M. G., Kraniologicheskii tip ulchei (Nani) [Cranial type of the Ulchi (Nani)]. AZH, No. 1, pp. 82-90, 1937.

orbital distance being relatively great. The face was orthognathous, with a slight tendency to alveolar prognathism. The development of the fossa canina was slight.

The series was not homogeneous, there being a wide range of variations.

Measurements on the living agreed with the craniological data.

The Ulchi (they call themselves "Nani") number only 723 individuals, according to the 1926 census. They live in the region of the lower Amur River between the regions occupied by the Giliaks and the Golds. They are described as a complex of clans of different origin, consisting of the Gold, the Orochi, the Ainu, the Manchu, and the Giliak.

Both in language and in culture the Ulchi are related to the Gold, but they have also been influenced by the Orochi and the Giliak, whom they most resemble craniologically. However, the Ulchi skulls possessed a lower cephalic index and a more retreating forehead than skulls of the Orochi and the Gold. Levin states that even Ainu admixture, if present, would not be sufficient to explain these differences, and suggests that the long-headed component of the Gold, who appear to be related to the North Chinese, may also be present in the Ulchi.

He also advances the hypothesis that this lower cephalic index among the Ulchi represents a Paleoasiatic admixture, present among many groups of the Evenks (Tungus). Recapitulating his characterization of the Pacific Ocean type of the Mongoloid race, which the Ulchi resemble, Levin states: "This type, scattered widely among the peoples of the Amur region, seems to be the basis on which the further formation of both Paleoasiatics and the Tungus-Manchus proceeded."

TWO TYPES OF YAKUT CRANIA

A. N. IUzefovich³⁶ states that the presence of two anthropological types among the Yakuts has been recorded by all investigators since Middendorff.³⁷

According to A. N. Nikiforov the Yakuts begin a description of a person by stating whether he has a long or a round face. Mainov³⁸ wrote that a "small percentage of the Yakuts have somewhat different

³⁶ IUzefovich, A. N., *Dva tipa Iakutskikh cherepov* [Two types of Yakut crania]. *AZH*, No. 2, pp. 65-78, 1937.

³⁷ Middendorff, A., *Puteshestvie na sever i vostok Sibiri* [A voyage to the north and east of Siberia], pt. 2. St. Petersburg, 1869.

³⁸ Mainov, I. I., *Naselenie Iakutii* [The population of Yakutia]. Leningrad, 1927.

facial traits from those of their compatriots. The aquiline nose of such Yakuts makes them somewhat resemble the American Indians."

Previous to IUzefovich's report, however, only four Yakut crania had been described (one uncertain Yakut, by Virchow in *Crania Ethnica*, 1882; and three by A. I. Kazantsev in *Trudy of the East Siberian Medical Institute*, 1935).

IUzefovich (1937, pp. 65-78) studied 34 crania that the Institute of Anthropology and Ethnography (IAE) of the Academy of Sciences of the U.S.S.R. had acquired between 1858 and 1928. Six of the series belonged to Dolgan Yakuts, who are considered to be Mongol-speaking Tungus and are treated separately.

From his study of the 28 remaining crania IUzefovich concluded that two distinct types actually exist among the Yakuts. He tabulated their characteristics as follows:

<i>Type 1</i>	<i>Type 2</i>
Brachycephalic.	Mesocephalic.
Small cranial height.	Great cranial height.
Chamaecephalic.	Hypsicephalic.
Tapeinocephalic.	Metriacephalic.
Broad-faced.	Very broad-faced.
Long-faced.	Very long-faced.
Mesoprosopic.	Leptoprosopic.
Mesenic.	Leptenic.
Hypsiconch.	Mesoconch.
Mesorrhine.	Leptorrhine.
Chamaestaphyline.	Orthostaphyline.
Mesognathous.	Orthognathous.

The first group reveals a strong likeness to the Tungus of the North Baikal region described by Roginskii.

The second group is characterized by feebly expressed Mongoloid characters. IUzefovich states, however, that this weakness of Mongoloid traits cannot be attributed to any Europeoid admixture.

He suggests that two types took part in the formation of the Yakuts, one of which had also played an important role in the development of the Tungus physical type.

CRANIOLOGY OF THE OROCHIS OF THE MARITIME AREA

M. G. Levin,³⁹ of the Anthropological Institute of the State University in Moscow, remeasured a series of 19 Orochi crania at the

³⁹ Levin, M. G., *Materialy po kranologii Primorskikh Orochei* [Materials for the craniology of the Orochis from the Maritime Area]. AZH, No. 3, pp. 323-326, 1936.

State Anthropological Museum which Ranchevskii⁴⁰ described in 1888. The collection was presented by the eastern Siberian branch of the Russian Geographical society.

The series consisted of nine male and eight female crania. Two children's crania were included.

Levin found the series to be relatively homogeneous. The crania were short, very wide, and of medium height. The cephalic index was 84.0. The forehead was straight, not broad, and the supraorbital region was of medium development. The prevailing skull forms were sphenoidal and broad-pentagonal. Muscular relief was slight. The occiput was flattened. The face was high, broad, and orthognathous (F.I. 52.8); the nose, medium (N.I. 46.8) and slightly prominent; the orbits, medium high. Horizontal and vertical facial profiles, as judged from the development of fossae caninae, were weak. Nine out of seventeen crania possessed a prenasalis.

Six crania had asymmetrical occipita. Levin was unable to conclude whether or not the deformation was artificial, that is, a result of the use of native cradles.

Three crania had "Inca bones."

After comparing these crania with those of other peoples of north-eastern Asia such as Giliaks (Trofimova), Tannu-Tuvans and Kemchik (Debets), Buriats and Kudiaks (Debets), Ainu (Trofimova), Tungus and North Baikal (Roginskii), and Aleuts (Tokareva), Levin concluded that the Orochis belong to the Central Asiatic variant of the Mongolian race but that they differed from other representatives of that type, such as the Tannu-Tuvans, in smaller head length, greater brachycephaly, and smaller cranial capacity. He therefore classifies them as belonging to the Pacific Ocean variant of the Central Asiatic type, to which Debets,⁴¹ following Montandon,⁴² attributed the Giliaks, the Aleuts, and the Tlinkits. Levin argues that the Aleuts differ greatly from the Orochis and the Giliaks in such essential characters as frontal, facial, and nasal angles, cranial height, and bizygomatic breadth. The Orochis and the Giliaks differ in growth of beard, the Sakhalin Giliaks including a heavy bearded type, which Debets found also among the so-called Amur Orochi.⁴³ Debets was not of the opinion that this characteristic was due to Ainu admixture.

⁴⁰ Morskoi sbornik, meditsinskoe pribavlenie, 1888.

⁴¹ Debets, G. F., Anthropological composition of the population of Baikal area in the late Neolithic period. AZH, vol. 19, Nos. 1-2, 1930.

⁴² Montandon, G., Anthropologie paléosibérienne. L'Anthropologie, Nos. 3-6, 1926.

⁴³ Debets, G. F., Ulchi. AZH, No. 1, 1936.

CRANIOLOGY OF THE ALEUTS

Tokareva⁴⁴ studied the osteological materials from the excavations of W. I. Jochelson⁴⁵ in connection with the Kamchatka Expedition of the Russian Geographic Society, 1908-1910. Jochelson, who excavated in the Aleutian Islands during 1909 and 1910, found 78 crania, 19 skeletons, and 617 bones in burial caves on the islands of Attu, Atka, Umnak, Amaknakh, and Uknadakh, and in burial huts on Unimak Island. Tokareva is now preparing for publication an extensive monograph on this material.

Tokareva summarizes the theories regarding the origin of the Aleuts. The early explorers believed them to be immigrants from Asia: Steller on the basis of some cultural elements, such as head-dress; Veniaminov (1840), on Aleut traditions. Schrenk classified the Aleuts as belonging to his Paleosasiatic group of peoples.

Dall was the first of the modern investigators to express the belief that the Aleuts came from America. He thought them to be of Eskimo ("Innuit") origin, but did not base his conclusions on any anthropological evidence beyond recording the extreme variability of the Aleut crania, ranging from dolichocephalic to brachycephalic. Jochelson, while criticizing Dall's theories regarding Aleut prehistory, shared his ideas concerning the American origin of the Aleuts. According to his conception of the history of the peoples of North America and Asia, the Paleosasiatic tribes of northeastern Asia (Chukchi, Koriaks, Kamchadals) are an Americanoid branch, closely connected culturally with the tribes of northwestern America.

According to Jochelson all these tribes represent the remains of an ancient cultural layer, the unity of which was disrupted at a definite period by the intrusion of a new ethnic group, the Eskimo. Constituting the apex of the Eskimo wedge, which divided the autochthonous population into an American and an Asiatic group, were the Aleuts.

According to Tokareva, Jochelson did not give adequate attention to the racial peculiarities of the Aleuts. Jochelson⁴⁶ pointed out the existence of a series of sharp differences between the Aleut and the Eskimo type (brachycephaly), and suggested that these differences

⁴⁴ Tokareva, T. IA. (State Museum of Anthropology, Moscow), *Materialy po kranologii aleutov* [Materials for Aleut craniology]. AZH, No. 1, pp. 57-71, 1937.

⁴⁵ Archaeological investigations in the Aleutian Islands. Carnegie Institution of Washington, 1925; History, ethnology and anthropology of the Aleut. Carnegie Institution of Washington, 1933.

⁴⁶ Jochelson, W. I., History, ethnology and anthropology of the Aleut. Carnegie Institution of Washington, 1933.

could be explained either as a result of mestization with a highly brachycephalic group (Athabaskan Indian), or in the course of local development under conditions of isolation.

L. S. Berg also shares Jochelson's views regarding the American origin of the Aleuts, without, however, touching upon the anthropological affinities.

Hrdlička has stated that the Aleuts belong to the Eskimo stock and has explained their physical differences from the Eskimos, particularly their brachycephaly, as the result of mestization with the Athabaskans. He bases this explanation on the postulate of a southerly migration of Eskimos from Alaska to the Aleutian Islands.

Montandon,⁴⁷ working with extremely limited material, connects the Aleuts with the Giliaks, and unites them into the "Aleut-Giliak type," a branch of the greater Mongoloid race. Biasutti shares this view, terming this branch "Aleutian."

Tokareva selected for investigation 32 male and 22 female crania, and 5 crania segregated into a special group as not typically Aleutian. This number of crania may be deemed sufficient for study, since the total number of Aleuts in 1937 was only about 2,000.

Jochelson attributed these crania to the period prior to the Russian invasion, i.e., during the middle of the eighteenth century. This eliminates the possibility of Russian admixture.

The age groups represented were as follows: 28 adult, 1 mature, and 3 subadult males; and 12 adult, 7 mature, and 3 subadult females. Measurements were taken according to Rudolf Martin's technique.

Neither artificial cranial deformation nor pronounced cranial asymmetry was observed. Three crania were affected by syphilis.

Preliminary examination revealed a group of five crania (three male, one female, one child) that differ sharply from the rest. As compared with the rest of the series, these crania have a straight forehead, a greater head height, a greater facial angle, and a lower face.

The extremely homogeneous male series of the main group, consisting of the 32 typical crania, has been described. These crania are medium in size, length (181.0), and breadth (146.57). The head height is exceptionally small, 127.05 (range 116-139).

A characteristic feature is the slanting forehead (66.2°) with a medium-developed browridge (1.52) and a well-developed glabella. The form of the head is subbrachycranial, while the pentagonal outline predominates. The bizygomatic breadth is 143.44 (range 127-

⁴⁷ Montandon, Georges, *Craniologie paléosibérienne*. L'Anthropologie, 1925.

153). The upper facial height is medium to high, 72.14 (range 65-81). The facial index of 51.57 (range 46.5-56.5) is mesoprosopic. The facial angle of 83.04 (range 76-90) is mesognathous. The facial form is elliptical, with medium-developed (1.84) fossa canina. The nasal index of 45.4 (range 35.5-53.4) is mesorrhine with a medium-developed nasal bone. The orbital height is above medium but tends toward being mesoconch.

The female crania are of smaller dimensions, both as to size and facial measurements. They are more brachycephalic, the frontal angle being smaller. The face is more protruding. The glabella, brow-ridges, and fossa canina are less developed.

After comparing Aleut measurements with the scheme proposed by Debets for Mongoloid, Europeoid, and Australoid (after Morant) races, Tokareva concludes that the Aleuts belong to the Mongoloid group, having neither Europeoid nor Australoid traits. Tokareva then compares the Aleuts with the racial groups of the second order, beginning with the Eskimo.

According to Jochelson,⁴⁸ the Aleutian language originates from a source common to all Eskimo dialects, and in all probability represents by itself one of the most ancient Eskimo dialects. The culture of the Aleuts is very close to that of the Eskimo. According to Tokareva there is, however, very little in common between their physical traits.

According to Jenness⁴⁹ the Eskimos are characterized by a relatively high skull, considerable dolichocephaly accompanied by a broad face, an exceptionally narrow nose and large cranial capacity. In all these traits the Eskimo skulls sharply differ from the average Aleut cranium.

There exists a much greater degree of similarity when Aleut crania are compared with those of the Tlinkits of northwestern America. The two series are very close together in size, bizygomatic breadth, facial height and index, and frontal angle. The main difference consists in Tlinkit crania having a greater head height and in being more brachycephalic. In head length and breadth as well as in facial and orbital indices both Aleut and Tlinkit crania resemble Hrdlička's⁵⁰ "mixed" group of Alaska.

Tokareva then compares the Aleut measurements with the cranial

⁴⁸ Jochelson, W. I., *Unanganic (Aleutian) language, the language and writing of the northern peoples*, pt. 2, 1934.

⁴⁹ Jenness, Diamond, *The American aborigines*, Toronto, 1933.

⁵⁰ Hrdlička, Aleš, *Catalogue of human crania in the United States National Museum collections*. Proc. U. S. Nat. Mus., vol. 63, art. 12, 1924.

measurements of other groups: Lake Baikal Neolithic Type A,⁵¹ Tungus,⁵² Tlinkits,⁵³ Chukchi (Hrdlička), Eskimo of Alaska (Hrdlička), Giliaks (Trofimova), Ainu,⁵⁴ Tuvinians,⁵⁵ and the Telengets (Bunak).

The Telengets have only the frontal angle and the facial height in common with the Aleuts. The Tannu-Tuvans, representing the Central Asian variety, have a much straighter forehead, a higher skull, a greater degree of brachycephaly, a higher face, a smaller bizygomatic breadth, and a narrower nose. The Aleuts, therefore, cannot be included in either of the two basic Mongoloid races of Siberia.

When the Aleuts are compared with the Giliaks (whom Montandon considered to belong to one race), it is found that the two types differ greatly; that the Giliak skulls are higher, more brachycephalic, possess straighter noses, greater facial angles, and broader faces than the Aleuts.

The Chukchis also differ from the Aleuts, having a smaller cephalic index, greater skull capacity, higher face, higher orbits, and a smaller bizygomatic breadth.

The Ainu has a straighter forehead, smaller facial height and breadth, and is more dolichocephalic.

The most amazing fact in connection with the determination of the racial affinities of the Aleuts was the discovery of their indubitable similarity in a number of traits with the populations of Lake Baikal area, particularly with the Tungus described by Roginskii. Both the Tungus and the Aleuts have exceedingly low skulls. According to Roginskii "The trans-Baikal Tungus are apparently one of the lowest-headed groups in the world." However, the Aleut skull is still lower than the Tungus (Tungus, 129.6; Aleuts, 127.75). Both these groups have great similarity in the frontal angle, in the orbital and nasal indices, and in the bizygomatic breadth. The facial index of the Aleuts is but slightly less than that of the Tungus, the latter possessing a slightly greater facial height.

The only differences between these two groups are the greater head

⁵¹ Debets, G., Anthropological composition of the population of Baikal area in the late Neolithic period. *AZH*, Nos. 1-2, 1930.

⁵² Roginskii, I.A., Materialy po antropologii tungusov severnogo Pribaikalia [Materials for the anthropology of the Tungus of the northern Baikal area]. *AZH*, No. 3, 1934.

⁵³ Fridolin, Amerikanische Schädel, *Arch. Anthrop.*, 1898.

⁵⁴ Trofimova, K Ainskoi probleme [A contribution to the Ainu problem]. *AZH*, No. 2, 1932.

⁵⁵ Debets, G., Kraniologicheskii tip Tannu-Tuvintsev [The craniological type of the Tannu Tuvans]. *Sovetskaia Aziia*, Nos. 5-6, 1930.

length of the Tungus, resulting in their dolichocephaly, and the greater facial angle.

A closely comparable type was found by G. F. Debets in the Neolithic sites of the Baikal area.⁵⁶ This is the so-called Neolithic "Type A" which almost coincides with the contemporary Tungus type of this region. The similarity to the Aleuts of the "Type A" skulls includes also the pentagonal form of the skull, of the lower border of the apertura pyriformis, and of the fossa prenasalis.

The main differences between these Neolithic and Aleut crania are the same as between the latter and the Tungus, the greater head length resulting in the accentuated degree of dolichocephaly of the Neolithic crania.

Trofimova compared the female Aleut skulls with six Asiatic groups.

CONCLUSIONS

The Aleut series of crania is of an unusually homogeneous character, disrupted only by the series of five skulls with straight foreheads.

Tokareva omits them on the basis of archeological evidence, concluding that they were very late arrivals (white color of crania present only in the higher strata at Atka Island).

A homogeneity of the main series then testifies to the absence of alien admixtures in the population of the Aleutian Islands during pre-Russian periods.

Tokareva quotes IArkho⁵⁷ and also Dubinin and Romashek⁵⁸ in support of the role of isolation as a factor "conditioning the development of the racial type of the Aleuts along a specific path, and stimulating the emergence of their distinguishing somatic characteristics."

Tokareva, while disagreeing both with the theory of the origin of Aleuts through mestization as proposed by Hrdlička and with that of Montandon about their kinship to the Giliaks, believes that the Neolithic type is still preserved among the Aleuts, having been modified as a direct result of island isolation.

The origin of the brachycephaly is due to genetic-automatic processes.

⁵⁶ See also Hrdlička's "Crania of Siberia."

⁵⁷ IArkho, A. I., *Ocherednye zadachi sovetskogo rasovedeniia* [The problems before Soviet race science]. AZH, No. 3, 1934.

⁵⁸ Dubinin and Romashek, *Geneticheskoe stroenie vida i ego evoliutsiia* [The genetic structure of the species and its evolution]. *Biologicheskii Zhurnal*, Nos. 5-6, 1932.

ORIGIN OF THE MONGOL

Roginskii⁵⁹ begins his study of the origin of the Mongol by giving a brief review of the literature.

In 1927 Hrdlička⁶⁰ expressed the supposition that modern man originated in the Neanderthal type. Later, Bartucz⁶¹ pointed out the remarkable similarity between the skeletal type from the Hun burials of the fourth and fifth centuries and the dolichocephalic variety of the Tungus, on the one hand, and Neanderthal man, on the other. More recently, Weidenreich⁶² stated the opinion that *Sinanthropus* possessed certain Mongoloid traits.

In an attempt to solve these problems, Roginskii⁶³ studied anthropometric data on the dolichocephalic peoples of Siberia, particularly the Tungus. In the Anthropological Institute of the University of Moscow he examined the mandibles and teeth of the Ulchi crania (cf. M. G. Levin) collected by A. M. Zolotarev in the Amur region in 1936, and of the Ostiak crania collected by D. T. Ivanovich near Obdorsk in 1911. He also made a study of the geographic localization of some of the Mongol characters in eastern Asia and of the intra-group correlations between them. As a result he came to the following conclusions concerning the origin of the Mongol type.

A comparison of physical characters of modern Mongoloid peoples in Siberia with those of *Homo neanderthalensis* revealed such differences as absence of the torus superciliaris, general weakness of the supraorbital crest, small dimensions of the molar pulp, and development of the chin. On the other hand, modern Mongols were found to resemble the Neanderthal type in their retreating forehead, very high mean height index, a slight development of the fossa canina, and large dimensions of the mandible.

Archeological evidence from the Neolithic and later periods indicates that the geographic area inhabited by the Mongol race was considerably smaller than it is today.

⁵⁹ Roginskii, I. A., *Problema proiskhozhdeniia mongolskogo rasovogo tipa* [The problem of the origin of the Mongol racial type]. *AZH*, No. 2, pp. 43-64, 1937.

⁶⁰ Hrdlička, Aleš, in *Ann. Rep. Smithsonian Inst. for 1928*.

⁶¹ Bartucz, Lajos, *Moson Szent Janos, Seminar. Kondakovianum, Prague, 1929*.

⁶² Weidenreich, Franz, *Peking Natural History Bulletin*, vol. 10, pt. 4, 1936.

⁶³ Roginskii, I. A., *Materialy po antropologii tungusov severnogo Pribaikalia* [Materials for the anthropology of the Tungus of the northern Baikal area]. *AZH*, No. 3, 1934.

ORIGIN OF THE ESKIMO

Basing his opinion on the new evidence from Point Barrow, north-western Alaska, the Bering Sea region, St. Lawrence Island, and other sites excavated by Collins, Zolotarev⁶⁴ accepts Mathiassen's views, in preference to those of Birket-Smith, regarding the origin of the Eskimo. From his study of the archeological materials he arrives at the following conclusions:

The most ancient proto-Eskimo culture is that of the Bering Sea. The archeological characteristics of this culture are distinct, although it is impossible at present to draw any conclusions regarding its social and economic status.

This culture came to the area of Bering Strait from the west, most probably progressing along the Arctic coast of Siberia. The art preserves a strong Paleolithic tradition, but the degree of its material production does not attain the level of fully developed Neolithic. It is very tempting to connect this culture with the ancient culture of the IAmal Peninsula. An assumption to this effect would find support in the close relation of the Samoyed and the Eskimo languages.

The theory of the Asiatic origin of the Eskimo receives a firm foundation in this new archeological evidence.

Having reached America during the stage of the "Bering Sea Culture," the ancestors of the Eskimo migrated eastward along the Arctic shore of America. There they formed the Thule culture, out of which developed the modern cultures of the Central, Polar, and Greenland Eskimos.

The culture of the contemporary Eskimos of Alaska was formed from the Bering Sea Culture. Having passed the Penuk stage, it was possibly affected by influences connected with the reverse movement of some of the Thule groups.

Examining the anthropological evidence,⁶⁵ Zolotarev draws further conclusions. The most ancient Eskimo type, homogeneous in the main, is dolichocephalic, with a high carinate skull. This type obviously came from Asia.

This type was displaced in Alaska in relatively recent times by tall brachycephals approaching the Paleoasiatic type.

Recognition of the dolichocephal as the most ancient Eskimo type

⁶⁴ Zolotarev, A. M., *K voprosu o proiskhozhdenii Eskimosov* [On the origin of the Eskimo]. *AZH*, No. 1, pp. 47-56, 1937.

⁶⁵ Cf. Hrdlička, Aleš, *Anthropological survey in Alaska*, 46th Ann. Rep. Bur. Amer. Ethnol., 1930; and *Melanesians and Australians and the peopling of America*, *Smithsonian Misc. Coll.*, vol. 94, No. 11, 1935. Also Diamond Jenness, *The American Aborigines*. Toronto, 1933.

once more poses the problem of the connection of the Eskimo with the dolichocephalic populations of the Upper Paleolithic period. Preservation of the Paleolithic tradition in Eskimo art permits the formulation of a hypothesis according to which the ancestors of the Eskimo were in the van of the northward movement of South Siberian populations, beginning at the end of the Paleolithic and the beginning of the Neolithic period.

OBSERVATIONS ON THE TIBIA

Zenkevich,⁶⁶ of the Section on Human Morphology and Genetics at the Anthropological Institute of the State University of Moscow, studied 56 tibiae belonging to middle-aged males who died from accidents. Zenkevich established the absence of any correlation between the form of the bone and its chemical composition. At the same time the correlation between massiveness, i.e., the ratio of the circumference measured in the middle of the shaft to the length of the bone, and chemical composition was significant. The more massive bones contained a lesser quantity of inorganic components (especially calcium) and more water and organic components (especially fat) than the smaller bones. The more massive bones were somewhat flatter in cross section.

HEAD FORM AND GROWTH IN UTERO

Madame Shilova,⁶⁷ of the Second Medical Institute in Leningrad, studied 725 human embryos and fetuses. She recorded a constant rise in cephalic index during the whole uterine life, there being a slight fall only after parturition. In 339 of 725 cases (56.2 percent) the child was brachycephalic (C.I. 80.0-84.9) at birth.

Shilova concludes that during uterine life the cranium passes from dolichocephalic to brachycephalic, that is, it undergoes the same changes as have the heads of the human race in general during the last millennium.

She points out the following details of this change: During the

⁶⁶ Zenkevich, R. I., *K voprosu o faktorakh formoobrazovaniia dlinnykh kostei chelovecheskogo skeleta, I. Variatsii formy secheniia bolshoi bertsovoi kosti v sviazi s udelnym vesom i khimicheskim sostavom kosti* [On the factors of formation of long bones in the human skeleton, I. The variations of the form of cross section of the tibia and its specific gravity and chemical composition]. *AZH*, No. 1, pp. 26-46, 1937.

⁶⁷ Shilova, A. V., *Materialy o formie golovy i roste v utrobnoi zhizni* [Materials on the form of the head and growth during uterine life]. *AZH*, No. 1, pp. 3-25, 1937.

first 3 months the cephalic index constantly increases, the prevalent skull form during this period being mesocephalic. From the fourth to the tenth month the index varies slightly, brachycephaly prevailing. The index decreases during the tenth month, as a result of parturition.

The fluctuation of cephalic index in different embryos may vary greatly in point of time. This is true with twins in the majority of cases.

In no instance does head breadth exceed head length. The curves of the absolute length and breadth are very similar to the curves of their absolute growth, by month. Head length increases more than head breadth up to and including the fifth month, which shows the greatest difference in increase of any month.

A definite periodicity governs the absolute increase of length and breadth of head, as well as length of body and leg. Up to the fifth month there is successively greater increase; from the sixth to the ninth month the increase fluctuates; the pre-parturient period is characterized by a sharp rise.

Sex dimorphism is clearly expressed. The cephalic index of girls in utero is lower than that of boys except during the last 2 months, when that of girls becomes greater. In general, newborn girls are more brachycephalic than boys. During the first half of uterine development girls surpass boys in their growth. The growth of all their dimensions is more evenly distributed between the two halves of uterine life than is that of boys, whose growth is shifted more to the second half.

A STUDY OF BLOOD GROUPS IN THE CAUCASUS⁶⁸

Anthropological study of blood groups in Georgia was begun in 1925 by the Hematological Department of the Georgian Bacteriological Institute. The blood groups of all patients in the Hematological and Wassermann Departments were recorded, together with data regarding sex, age, and nationality.

One thousand measurements disclosed tentatively the prevalence of Group I (O) among the Georgians and of Group II (A) among the Armenians. The extreme western and eastern groups represented the maximum range of brachycephaly and dark pigmentation. The highest degree of both was found in the east, the lowest in the west.

⁶⁸ Semenovskaia, E. M., *Izuchenie grup krovi narodov Kavkaza* [Study of blood groups in the Caucasus]. *Sovetskaia Etnografia*, Nos. 4-5, pp. 213-215, 1936.

Group II (A) became proportionately more rare toward the west, while Group I (O) increased in frequency.⁶⁹

In 1929 the editorial office of the "Problems of Biology and Pathology of Jews" sponsored a study of the blood groups of Georgian and Persian Jews. The material was collected in Tbilisi and Kutaisi. Altogether 3,409 examinations were made on various Georgian tribes and 1,422 on Jews. The four blood groups were normally represented, while the distribution of percentages was similar for Georgian and Persian Jews and for Romanian, Balkan, Russian, and Polish Jews. Blood groups of the Jews did not correspond to blood groups of the Georgian tribes. This was explained by the absence of interbreeding between the two peoples, owing to religious handicaps. On the other hand, Dzhavachishvili⁷⁰ states that the Georgian Jews are anthropologically a metamorphic Georgian group, who have for many centuries lived alongside the Georgians and adopted their language.

In 1930 an article⁷¹ on the blood groups of Georgians appeared.

On the basis of more than 6,000 examinations, it was discovered that Group I (O) predominated in the west, while Groups II (A) and IV (AB) were rarely present. Percentages for Group II (A) increased strongly to the east, together with those for Group III (B), owing to the influence of Armenians, 50 percent of whom belong to Group II (A), and the influence, especially in the east, of Mongoloid elements. Not all the peoples of the Caucasus have been examined, owing to the inaccessibility of many of the mountain tribes. A number of expeditions now in progress are expected to complete the survey.

In 1930 Dr. Ukleba conducted an expedition to Svanetia for the First Clinical Institute of Georgia, Tbilisi. Five hundred and seven measurements were taken, and it was discovered, strangely enough, that percentages for Group I (O) increased in the more mountainous regions.

In 1932 Dr. Kvirkelia, a member of an expedition led by Professor Machavariani, collected materials among the Adzhars, Gurians who have been Islamized. The distribution of blood groups was found to be typical for western Georgia, with an increase of Groups II (A) and III (B) in the regions nearest the Turkish frontier.

⁶⁹ Cf. AZH, vol. 15, Nos. 3-4.

⁷⁰ Ost-Rundschau, No. 9, 1930, and Problems of Biology and Pathology of Jews, No. 3, pt. 1, Leningrad, 1930.

⁷¹ Ukrainisches Zentralblatt für Blutgruppenforschung, vol. 4, pt. 4, 1930.

*Blood groups (from Semenovskaia)**

Peoples	Individuals	I (O)	II (A)	III (B)	IV (AB)
Adzhars	700	<i>51.57</i>	<i>36.57</i>	<i>5.71</i>	<i>0.15</i>
Svanetians	507	<i>56.21</i>	<i>34.91</i>	<i>6.90</i>	<i>1.97</i>
Mingrelians	519	<i>54.72</i>	<i>32.75</i>	<i>8.48</i>	<i>4.04</i>
Imeretians	663	<i>50.52</i>	<i>35.14</i>	<i>10.86</i>	<i>3.47</i>
Lechkhums	20	11	6	3	
Gurians	265	<i>51.31</i>	<i>36.98</i>	<i>9.81</i>	<i>1.88</i>
Rachins	183	<i>40.43</i>	<i>37.70</i>	<i>17.48</i>	<i>4.37</i>
Kartalinians	611	<i>41.72</i>	<i>40.59</i>	<i>51.29</i>	<i>6.38</i>
Kakhetians	489	<i>36.19</i>	<i>42.74</i>	<i>16.15</i>	<i>4.9</i>
Khevsurs	2	4	4		
Mokhe	7	3	2	2	
Tushins	6	1	3	2	
Lezghians	1	1			
Daghestan mountaineers...	1			1	
Chechens	4	2	2		
Osetes	142	<i>38.02</i>	<i>41.14</i>	<i>15.49</i>	<i>6.33</i>
Georgian Jews.....	1239	<i>26.95</i>	<i>43.09</i>	<i>19.12</i>	<i>10.73</i>
Persian Jews.....	127	<i>20.49</i>	<i>47.57</i>	<i>23.62</i>	<i>8.65</i>
European Jews.....	95	<i>25.26</i>	<i>48.42</i>	<i>20.01</i>	<i>6.31</i>
Assyrians	6	1	3	2	
Armenians	906	<i>28.80</i>	<i>51.76</i>	<i>10.81</i>	<i>8.6</i>
Russians	315	<i>31.42</i>	<i>38.41</i>	<i>17.79</i>	<i>12.38</i>
Poles	14	6	3	3	2
Mordvinians	1		1		
Komi	2		1		
Esthonians	1		1		
English	1		1		
French	2		1	1	
Germans	15	5	8	1	1
Latvians	2	1	2		
Lithuanians	3	1	1	1	
Greeks	19	13	5	1	
Gypsies	2			2	
Chinese	1	1			

* Figures in italics are percentages. Note errata in Khevsur, Komi, and Latvian groups.

On the basis of 3,775 examinations on Georgians, the following percentages were obtained:

Group	Percent
I (O)	50.32
II (A)	36.31
III (B)	10.33
IV (AB)	3.02

The formula for the groups was O>A>B. Among the Kakhetians A>O>B was particularly characteristic. This ratio was also noted

as present among the Armenians, Ossetes, and Georgian Jews. Among the more easterly groups the percentage of Group III (B) also increased, and it was particularly high among the western Georgians and Imeretians. It reached 15 percent in the Shorap region, through which the high mountain road passed, and among the Rachins, east Georgian people who were pushed westward.

In spite of the position of the Caucasus between Asia and Europe, neither the Georgians nor the Armenians were found to belong to the intermediate serological type, both being generally classed among the European peoples. A tendency toward the Pacific type was noted in western Georgia. The Armenians and the Georgian Jews showed a greater percentage of A than O groups. The Turks alone could be considered as an intermediary type, owing to the admixture of Mongoloid elements.

Blood grouping⁷² was continued during 1936 by the Tiflis [now Tbilisi] Branch of the Russian Institute for Blood Transfusion and by various medical expeditions in Georgia.

ISOAGGLUTINATION OF THE TURKOMANS

Ginzburg⁷³ studied blood samples from 562 Turkomans of various regions, which he collected during an expedition in 1936 under the sponsorship of the Anthropological Institute of Moscow State University.

This expedition investigated two of the three large, historically known groups of Turkomans: the eastern Turkomans, seventeenth-century settlers along the middle course of the Amu River, in the Chardzhui and Kerkin regions of the former Khanate of Bukhara, now forming the eastern portion of the Turkoman S.S.R.; and the Transcaspians Turkomans of the region between the Caspian Sea and the Amu. The Transcaspians Turkomans were divided into a central group, dwelling along the Murgab and Tedzhen Rivers, and a western group, living near Ashkhabad and farther to the west.

A third large group, located in the former Tashauz region of the Khanate of Khiva (now the northerly section of the Turkoman

⁷² During 1936-1938 the Anthropological Section of IAE obtained copies of individual measurements described in this article. Other materials have been forwarded from the Central Blood Transfusion Institute, Tbilisi, and from Dr. V. N. Chuprinin, of that city. At the present time the Anthropological Section has 16,000 catalog cards of individual blood measurements from the Caucasus. This collection is increasing rapidly.

⁷³ Ginzburg, V. V., *Izogemoagglutinatsiia u Turkmen* [Isoagglutination of Turkomans]. AZH, No. 2, pp. 79-82, 1937.

S.S.R.), had been studied by an expedition under the leadership of IArkho,⁷⁴ who also collected blood samples.

From his own data and those of the other investigators, Ginzburg draws the following conclusions:

Group A is predominant over group B in all districts, the general formula being $A > O > B$. The ratios of blood groups among Turkomans of different tribes and different geographic areas are relatively similar. Group B increases slightly toward the east, Group A toward the west. In spite of great tribal and clan isolation and unceasing intertribal feuds supported by the chiefs, contact exists between various groups. The wide expanse of territory does not, apparently, present any obstacle to intercourse among separate tribes; wives are purchased from other districts, strangers are received into the clans, and slaves are captured during raids.

It is not possible to determine race from a study of blood groups, as the direction of variability does not always coincide with that of physical type. This study is of value, however, for ascertaining the degree of isolation of given tribes or populations of given territories.

THE TARDENOISIAN SKELETON FROM FATMA-KOBA, CRIMEA ⁷⁵

In 1927 S. N. Bibikov and S. A. Trusov conducted a preliminary sounding in the Fatma-Koba rock shelter in Baidar Valley, 3 kilometers northwest of Urkusta, between Sevastopol and Yalta.

There, in a specially dug pit, they discovered the Tardenoisian skeleton, which G. A. Bonch-Osmolovskii ⁷⁶ excavated during the same year and reported in a preliminary account of the excavations. The burial was removed in a block to Leningrad, where it is on exhibit ⁷⁷ in the Geological Museum of the Academy of Sciences. The skull, which had been shattered, was reassembled, and the other-

⁷⁴ IArkho, A. I., *Turkmeny Khorezma i Severnogo Kavkaza* [The Turkomans of Khoresm [Khwarazm] and of North Caucasus]. AZH, Nos. 1-2, 1933.

⁷⁵ This section is translated and summarized from the article by G. F. Debets, *Tardenuazskii kostiak iz navesa Fatma-Koba v Krymu* [Tardenoisian skeleton from Fatma-Koba rock shelter, Crimea]. AZH, No. 2, pp. 144-165, 1936.

⁷⁶ Bonch-Osmolovskii, G. A., *Itogi izucheniia krymskogo paleolita* [Results of the excavations of the Crimean Paleolithic period]. Trudy, First INQUA Conference, Fasc. 5, 1934.

⁷⁷ I saw this skeleton on October 17, 1934. My scanty notes do not differ from Debet's observations. The artifacts appeared to belong unquestionably to the transitional period. A monograph has been written on the Fatma-Koba skeleton, which I examined in Leningrad on July 2, 1946. Mrs. David Huxley has translated the French summary of the detailed study of the hands of this skeleton by Bonch-Osmolovskii. (H. F.)

wise well-preserved skeleton has been left in the position in which it was found, the right side partly embedded in the earth. Only the left arm and leg bones and the skull could be examined.

The skeleton was flexed; the head pointed south-southeast. It was covered with large stones. Debets expresses the opinion that the highly flexed position may indicate that the corpse had been hamstrung.

The pit, lying under two unbroken strata containing implements of Upper Tardenoisian type, was dug in another stratum containing the same type of implements. No artifacts were found, however, in direct association with the skeleton. In the underlying stratum a hearth was associated with implements of the Shan-Koba type (Azilian stage). Debets concludes that the stratum containing the skeleton and the uppermost cultural deposit belong to about the same period, a late facies of the Tardenoisian stage.

He suggests that the skeleton was that of a man approximately 40 years of age. The sutures of the skull were open except for a slight obliteration of the sagittal suture. A few teeth were well worn, but caries was absent. The enamel remained only on the crown of the molars and the incisors were approximately half eroded.

Debets records almost 200 measurements on the skull and skeleton. He states that the Fatma-Koba skeleton has all the characteristics of *Homo sapiens*. The full development of a large number of traits distinguish it from *Homo neanderthalensis*.

Debets enumerates the following points in which this skeleton differs from the Neanderthal type: cranial height, slant and convexity of forehead, development of browridges, occipital projection, slant of the main portion of the occipital bone, facial height, breadth of the ascending ramus, size of teeth, condylo-diaphysial angle of the humerus, bowing of the radius, platycnemic index, bowing of the femur, popliteal index, retroversion of the tibia, and tibio-femoral index. The chin and fossa canina were moderately developed. Prognathism was present but within the range of *Homo sapiens*. The situation of the radial tuberosity in relation to the volar plane, although not highly characteristic of man, was also within this range.

In a few points concerning massiveness of bones, that is, in the index of robusticity and the size of the epiphyses of the long bones, and in the development of muscular attachments, the Fatma-Koba skeleton resembled *Homo neanderthalensis*.

The only cranial trait approaching that of *Homo neanderthalensis* was the angle of the plane of the foramen magnum.

On account of its low face, pronounced horizontal profile, high

glabella, nasal prominence, and broad nasal bones, slightly narrowed in the middle, Debets classified the Fatma-Koba skeleton as belonging to the Europeoid racial group. The proportions of the extremities also approached those of the contemporary Europeoid, with the exception of the somewhat greater length of the tibia.

Only a moderate degree of general, but not alveolar, mesognathism differentiates the Fatma-Koba skull from the Europeoid type. According to Debets, the possession of this Negroid characteristic places this skull in the category of secondary Europeoids with slight Negroid affinities.

Debets adds that such tendencies are present in the Grimaldi crania, Combe-Capelle, skull No. 4 from Predmost, skulls from the Portuguese kitchen middens of Mugem and Cabeco da Arruda, the child's skull from Genière grotto in the Rhone Valley, the Moniat skull from Belgium, Ostorf Island (Jutland) crania described by Schlitz;⁷⁸ Chamblande's skulls from Switzerland, Silesian crania described by Reche, crania from Conguel described by Hervé, Verneau's⁷⁹ two crania from Caverno del Sanguinetto in northern Italy, and some modern Italian crania.

These traits, according to Debets, are the vestiges of an ancient stage of development common to all Eurafrican races.

⁷⁸ Schlitz, A., Die Steinzeitlichen Schädel des grossherzoglichen Museums Schwerin. Arch. Anthrop., vol. 7, pts. 2-3, 1908.

⁷⁹ Verneau, R., Les grottes de Grimaldi, vol. 2, pt. 1. Monaco, 1906.



AKHSHTYR CAVE, 120 METERS ABOVE MZYMTA RIVER, ABKHAZIA



GENERAL VIEW OF MZYMTA GORGE FROM AKHSHTYR CAVE, ABKHAZIA

Mrs. S. N. Zamiatnin in foreground.



CROSS SECTION OF AKHSHTYR CAVE, ABKHAZIA

1, Ashy stratum containing pottery (Circassian, early medieval, and first centuries A.D.); 2, brown rubble containing, in the upper part, Neolithic, in the lower, Upper Paleolithic, objects; 3, yellow rubble and talus of stalagmite, with Mousterian culture; 4, purple-brown clay, sterile; 5, gray calciferous clay, Mousterian finds; 6, gray-green silty clay, single Mousterian flints in the upper part; 7, ochre-yellow clay containing crystalline and shale gravel, sterile.



DR. M. E. MASSON (RIGHT) AND DR. L. V. OSHANIN EXAMINING SKULLS APPROXIMATELY 1,500 YEARS OLD FROM KHWARAZM, UZBEKISTAN



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