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OBSERVATIONS ON THE SCORPIONS OF LEBANON

By

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SCORPIONS OF LEBANON

Sammak

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ABSTRACT

One thousand and ninety-six specimens of Scorpio maurus of the family Scorpionidae and nine hundred and sixty-seven specimens of Buthotus judaicus and Buthus acutecarinatus of the family Buthidae were collected in Lebanon from October 1961 to November 1962.

The identifications were made by Dr. H. L. Stahnke and constitute the first authoritative identification of the scorpions of Lebanon. Scorpio maurus is the common scorpion of southern Lebanon, Buthotus judaicus the common scorpion of northern Lebanon. Buthus acutecarinatus was rarely collected.

The behavior of the two families are compared.

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I. INTRODUCTION

Scorpions, the topic of this thesis, were selected for study since they are relatively common in Lebanon and occasionally prove harmful to people because of their poisonous sting.

Scorpions occur most frequently in the tropical regions of the world. Several species are found in Greece, Italy, Spain and in the Balkans. In America they occur from Patagonia to the southern parts of the United States. They are absent from many islands, including New Zealand.

II. HISTORICAL REVIEW

Crandall (1913) wrote extensively on scorpions and their habits. He found that they are very retiring, and light is so distasteful to them that unless provided with a place to hide they will not feed. They are nocturnal, like moisture and they live a solitary life. Savory (1935) reported that the scorpion's coloration tends to protect it from attacks. Stahnke (1956) reported: "around human habitation scorpions thrive in the accumulation of old lumber, boxes, rags, brush, bricks and deserted places which offer them protection from adverse weather conditions and enemies and also provides them with enough soft-bodied insects, spiders and other animals upon which they feed". Herms (1950) reported that in some localities where the scorpions are abundant and dangerous, the powder of Chrysanthemum or Creoline has been used to drive scorpions away or even kill them.

The smaller scorpions of the temperate zones are rarely dangerous to man but the sting of the larger tropical species may cause severe and even fatal systemic reactions.

Savory (1935) wrote about the general anatomy of the order but Snodgrass (1952) treated the subject much more extensively. Brues et al (1954) gave a classification of scorpions including the main characteristics of each group.

Field (1955) reports that he found two species of the family Scorpionidae and six species of the family Buthidae in Iran, Syria, Jordan, Palestine and Iraq. Hegner (1936) discusses reproduction in scorpions and states that scorpions do not lay eggs but that the young are born alive. The young ride on the back of their mother for about a week and then become independent. Scorpions reach maturity in about five years.

Serfat and Vachon (1950) report the young are born during the night, all at one time, but occasionally two batches are separated by an interval of one day. Fabre (1907) and Waterman (1950) state that the young, which are born enveloped in the chorion, are freed by their mother, but Serfat and Vachon (1950) state that the young free themselves without any help. Cloudsley-Thompson (1955) states that the process of climbing the mother's back may take two hours since the young are heavy and weak. Schultze (1927) reported that the young remain on their mother's back until after the first molt (about ten days). Fabre (1907) described the courtship of scorpions for several species as did Serfat and Vachon (1950). Schulov and Amitai (1956) described the mating habits in some species of scorpions, and Schulov et al. (1956) described parturition. During the courtship dance of scorpions the male produces a special reproductive organ which forms a temporary penis, by which he inserts sperms into the female genital system.

Stahnke (1945) states that scorpions can survive for long periods without food; that for example Hadrurus sp. can remain four

or five months without taking food. According to Waterman (1950) the West Indian scorpion can survive three or four months without food but only when water is available. Lankester (1883) found great difficulty in feeding Australis sp. Cloudsley-Thompson (1955) found that the same species in the laboratory ate at least one cockroach per week during the summer months. Stahnke (1945) reported that Hadrurus sp. eats all soft-bodied insects but rejects woodlice and harvestmen except when hungry and then will eat hard beetles and even small lizards. Pocock (1893) and Schultze (1927) found that various species of the family Blattidae seemed to be preferred by Longimonus sp., although crickets, earwings and larvae of various coleopterans were also eaten.

According to Vachon (1953) it is not clear how the scorpions first detect their prey since the eyes of these nocturnal animals are simple. Stahnke (1956) reported that a large scorpion was observed eating a small lizard while a gravid female ate small bits of semi-dried manure. He reported further that female scorpions often eat their own young shortly after birth.

In 1938 Stahnke described the venomous effects of some Arizona scorpions and found that two types of poisons exist. The first type has a local effect. The skin, immediately after the sting, swells noticeably and becomes red and painful to the touch. This type is comparatively harmless to man. The second type has a neurotoxic effect resembling some kinds of snake venom. The latter type may be dangerous. Cloudsley-Thompson (1958) reported that the scorpions of

Southern France produce about 8mg. of fluid poison while the sting of the Australian scorpion, Androctonus australis L.1758, has been found to produce enough venom to kill a man within about four hours and has a toxicity almost equal to the venom of the cobra.

Cloudsley-Thompson (1958) discussed the enemies of scorpions saying that man is not the only enemy of these animals since other enemies also destroy scorpions. Some of these are ants, centipedes, spiders, lizards, snakes and birds. He stated also that scorpions were sometimes parasitized by various mites and nematode worms.

III. MATERIALS AND METHODS

Scorpions are collected from their burrows in the following ways.

A strong thread tied to a piece of beeswax is pushed inside the burrow and the free end of the thread tied to a long forceps. It is shaken gently in order to attract the scorpion's attention. The scorpion grasps the wax with its pedipalps, is unable to free itself and is picked up with the long forceps and preserved in 70% ethyl alcohol or kept for behavioral study.

Whenever the burrow is narrow and crooked, a stem of a plant bearing a small terminal flower is pushed inside the burrow and shaken. The disturbed occupant grasps the stem firmly and is withdrawn.

In special cases, i.e. when the burrow is very deep or protected by stones, a mature male scorpion is tied securely to the sting and allowed to dangle in the burrow. Females usually grasp the struggling "bait scorpion" and can be pulled out of their burrows.

Long forceps are the best collecting device for scorpionids which dig a small, straight, shallow burrow. The procedure is simply to push the forceps straight down in the burrow, grasp the scorpion and pull it out.

Digging is employed when all other collecting methods fail.

The substratum on which the scorpions used in behavior studies was collected and placed in glass terraria with the living material.

Because living specimens are very hostile to one another under crowded conditions, only a single specimen was placed in each collecting bottle.

Living specimens were fed spiders, beetles, Hemiptera (family Pyrrhocoridae), isopods, millipedes and cockroaches. Several drops of water were added daily to the soil and the temperature of the laboratory was recorded daily. Precise observations and daily checking were routine for all specimens. Dead material was preserved in 70% ethyl alcohol. After each trip the specimens were cleaned and examined under the binocular microscope. Specimens that showed differences were put in separate bottles. Some of the specimens were classified to family using the key of Brues, et al. (1954).

Since there are no local specific keys, several specimens of each collection were sent for identification to Dr. H. L. Stahnke of Arizona State University.

Specimens which were sent for identification were tagged and wrapped in gauze dampened with 70% alcohol and sealed in nylon bags.

The remaining specimens have been placed in the Museum of Natural History at the American University of Beirut.

IV. RESULTS AND DISCUSSION

The following information is the result of eighty-three field trips made during 1961 and 1962 to different parts of Lebanon. Fig.1 shows the collecting materials which were used.

Two thousand and sixty-three specimens were collected during the trips. Most of them were mature females but many were immature specimens. Only a few were mature males. One hundred and seventy-two specimens were brought alive to the laboratory and put into glass terraria for behavioral studies under laboratory conditions (Fig.2). One hundred of them were members of the family Scorpionidae. Although scorpions are nocturnal, most of the trips were made early in the morning as well as several during the night when car lights and a torch was used. It was very difficult to find the scorpions, especially at the beginning of this work, since they hide in such a way that few signs lead to their burrows. However a small well hidden oval opening can generally be located either under a stone (Fig.3) or protected by a thorny plant. Their burrows possess an oval opening about 3 cm. in diameter and are between 17 and 32 cm. long, being parallel to the earth's surface.

The majority of the specimens were collected ~~was~~ from mountainous areas, from 200 meters to 1800 meters above seal level where the soil was limy and generally covered with scattered calcareous

rocks. A large number of shrubs of the Mint family are found in the same region as the scorpions as well as many of the Xeric, thorn-bearing plants. Specimens of only two families of scorpions were found in Lebanon, namely the families Scorpionidae and Buthidae. Since all of the specimens of each family showed insufficient variation to justify separation into more than one species each, they are treated as such throughout the remainder of this paper. Such a course seems further justified since authorities to which material was sent for identification were reluctant to give more than tentative determinations to the specimens. The exception in this case might be the material belonging to the family Scorpionidae, specimens of which were identified by H. L. Stahnke as Scorpio maurus L. 1758.

Both families hibernate during the winter months. For this reason very few specimens were collected during that period. Most of the collecting was done during the summer season from July to October.

Several color photographs were taken of the scorpions in their artificial habitat in the laboratory (Fig.2), as well as several photographs in their burrows and natural habitat (Fig.6). Figure 7 shows the mating process, figure 8 feeding, behavior, cannibalism in figure 9 and fighting between individuals in figure 10.

1. Family Scorpionidae

Members of this family are brown to dark brown in colour, from 2.5 to 7 cm. long by .8 to 1.3 cm. wide (Fig.12). They have three lateral eyes on each side of the anterior end of the carapace

with two median eyes, one on each side of the median groove. The sternum is large and pentagonal, but generally as large as or larger than the genital plate which lies posterior to it. The legs possess spines in the connecting membrane between the last two tarsal joints; only on the outer side. Pectine with 7-11 teeth. The number of teeth often varies even in the same individual from right pectine to left. Postabdomen with four basal segments each having a pair of longitudinal keels near the median line. Last segment of postabdomen simple, lacking a spine beneath the sting. Upper side of chela usually rounded and without a keel.

As shown in the map this family is widely distributed in Lebanon. No specimens were collected in the extreme north and north-eastern parts of Lebanon. The habitat of this region does not appear to be suitable for scorpions of this family. It is not clear to me why, but edaphic features seem most important.

Members of this family are found in regions covered with red sandy soil, the vegetation of which is of the semi arid to arid type. Thorny plants, both herbaceous and woody, predominate in this mountainous area, with the families Compositae and Labiatae very abundant. Individuals live in burrows between 17 to 32 cm. long with an oval opening of about 1.5 cm. in width (Fig.3).

Mating behavior is often observed in this family. After finding a female, the male grasps her pedipalpal claws with his own and walks sideways, the female following him without resistance. The entire operation is directed by the male and takes from 2 to 3 hours.

During this time the male finds a suitable place and digs a hole. Actual copulation takes place after the male has taken the female into the burrow or to some other suitable retreat. The male protrudes a special organ which forms a temporary penis by which he inserts the sperms. In this family, the female kills and eats the male after mating (Fig.7A).

Females of this family are usually found with 14 to 30 young during the months of July, August and September. Each immature scorpion is 1.1 cm. long by .3 cm. wide at birth. After birth young scorpions stay on their mother's back for 12 to 18 days. If one of them falls off and seems too weak to climb back again she eats it at once. Only strong individuals survive.

Individuals of this family can survive for long periods without food. Several experiments were done on this and it was shown that scorpionids can remain alive four or five months without food. Scorpions feed mainly on cockroaches and spiders but also eat harder-bodied insects such as beetles and Hemiptera.

Usually scorpionids do not search for food but wait for insects to come to their burrow to hide. When hungry they move slowly forward with tail raised and pointed forward. They frequently hesitate in their movements and act of capture seeming almost accidental, an act of self defence rather than attack. When the prey is active and strong, the scorpion will even withdraw temporarily. Finally the prey is seized in the claws and by a backward-downward thrust of the tail-like abdomen the stringer is inserted. The paralyzed prey is then crushed and eaten.

Members of this family are cannibalistic and will readily eat smaller scorpions or those of their own size which they catch while still teneral. Females will often eat their own young shortly after birth.

In this family males and females are distinct and show small but visible differences in the relative proportions of their bodies. The male is more slender and has a longer tail (Fig.12).

In the laboratory the members of this family seemed to be more sensitive to light and tend to dig burrows in the sand of the terraria. They are hydrophilic and cannot survive high temperature. All but two died, apparently for this reason. This was no doubt due to the fact that their natural habitat differs greatly, (22 to 27°C), from the laboratory habitat, especially in temperature and humidity. All the pregnant females died in the laboratory before giving birth to their young, probably because they could not withstand the new environmental conditions.

Specimens of this family which were brought to the laboratory seemed to be passive, except during the night when they became active. Obviously their nocturnal habit is a response to a highly negative phototaxis.

All specimens of this family live a solitary life, even in the laboratory. When they confront one another they fight vigorously. This may be due to the fact that family Scorpionidae is a cannibalistic group of animals from the observations made in the laboratory. The stronger scorpion eats the weaker member after killing it (Fig.9 & 10).

It should be remembered, however, that many animals respond to crowding by becoming unusually aggressive. That this could be a factor in the antagonistic behavior of specimens of this family when kept in the laboratory cannot be discounted.

Ants are one of the natural enemies of these scorpions and may attack, kill and eat them.

2. Family Buthidae

Members of this family are dark in color and from 8 to 11 cm. long by .9 to 1.4 cm. wide (Fig.11). They have three lateral eyes, at equal distances from each other on each side of the anterior end of the carapace, with two median eyes, one on each side of a median groove. The sternum is small and triangular. Tarsal joints of the third and fourth pairs of legs possess a spine at their tips. Pectine with 23 to 29 teeth, the number often varying in the same individual from the right pectine to the left. The last segment of the postabdomen is large and simple, without a spine beneath the sting.

This family is less well distributed in Lebanon than the family Scorpionidae. They appear to be concentrated in the northern and northeastern parts of Lebanon almost exclusively. This probably indicates that they are better adapted to living in drier and less mountainous regions.

Members of this family are found in regions which are much lower and warmer than that of the family Scorpionidae (30-34°C). Their normal habitat tends to be barren except for some thorny plants growing

in red sandy soil covered with small rocks or loose stones.

Individuals of the family Buthidae generally live under small calcareous rocks and loose stones or in cracks in the soil. Sometimes during the breeding season they dig burrows in the soil. The burrow has an oval opening, but is larger than those of the family Scorpionidae, because these scorpions are generally larger. Their burrows are horizontal and are 35 to 55 cm. in length.

Mating behavior is rarely seen in this family since they are very active and will run away when approached. Also, the burrow in which they mate is very deep. It is known, however, that the male grasps the female by the pedipalps and walks sideways and backwards while female follows him. This is followed by a maneuver during which the two animals face each other, forcibly straighten the caudal parts of their bodies and compress their abdomen to the ground with their tails extended upward. The whole operation is directed by the male and requires about one hour and a half to complete. When copulation takes place the male takes the female to the burrow he has constructed. In this family the male is also killed and eaten by the female after mating (Fig.7B). Females of this family are usually found with 5 to 12 young, during the same period as in the family Scorpionidae. Juvenile scorpions of this family are 1.4 cm. long by .4 cm. wide and stronger than those of the family Scorpionidae.

During the period after birth young buthids stay on their mother's back for 7 to 12 days after which they leave and seek their own food. When they are born, they are already robust and therefore not in need of long periods of protection.

Individuals of this family cannot withstand a food shortage for long periods. Laboratory experiments on this family showed that a well fed buthid can remain alive from 33 to 57 days only if water is available. This is due to the fact that they are relatively large and very active. Therefore they need relatively larger amounts of energy. Their food consists mainly of cockroaches, spiders, beetles, Hemiptera and moths. As in the family Scorpionidae they prefer soft-bodied animals such as spiders and cockroaches for food.

Generally speaking scorpions of this family actively seek their food. They move slowly forward with their tails well elevated and pointed forward, and attack their prey by holding it with the pedipalps and stinging it. The victim is then crushed and eaten.

Scorpions of this family are also cannibalistic, as are scorpionids, and will readily eat smaller scorpions, either those of other species or those of their own species which they catch soon after molting while their body surface is still soft. Females of this family will often eat their own babies shortly after birth. Males and females are distinct in this family. The male is more slender and has a longer tail. (Fig.11).

In the laboratory, specimens of this family seemed to be less sensitive to light. They do not dig burrows as deep as those of the scorpionids except during the breeding season. They are relatively active even during the day time. All the pregnant females, that were brought to the laboratory, lived but did not give birth probably because of the changed environment. Generally all living specimens of this family seemed to be active and strong both day and night.

Although specimens of this family live a solitary life in nature they exhibit a certain type of social life under laboratory conditions. This fact enables them to live better under artificial conditions. They live well in groups in laboratory and they never fight with one another. However, they fight other scorpions quite readily. Several observations showed that individuals of this family can kill individuals of the family Scorpionidae easily. Death occurs in about a half hour, after which time the living scorpion eats the dead one.

Ants killed and ate several of the individuals in the laboratory and thus may be important enemies in nature. It is very interesting to compare these two families in the following table.

Points of Comparison	- Family Scorpionidae	- Family Buthidae
1. Size and color	- Small, brown.	- Large, black.
2. Habitat preference	- High cold areas that are covered with red sandy soil in which they dig their burrows.	- Low warm areas that are covered by red sandy soil over which small rocks are separated and under which they are found.
3. Food preference	- Spiders and cockroaches	- Spiders and cockroaches.
4. Behavior	- Aggressive and very sensitive to light	- Less aggressive and less sensitive to light.
5. Litter	- Small and many in number.	- Large and few in number.
6. Type of life	- Solitary in burrows which are small and shallow.	- In groups, may be found in burrows which are large and deep.
7. Activity in laboratory	- Passive.	- Active.
8. Feeding habits	- Do not seek food.	- Does seek food.
9. Resistance under the laboratory conditions	- Not resistant.	- Resistant.
10. Reaction to one another	- No reaction.	- Hostile to scorpionids.
11. Effect of poison on man	- Weak, not fatal.	- Painful, not fatal.

Although both families occur in different habitats as seen from the comparisons above, these organisms may inhabit the same area, largely because they prefer the same food. When this happens they react competitively. Since the individuals of the family Buthidae are larger, stronger and can kill individuals of the family Scorpionidae, it becomes the dominant family. Both families inhabit a particular habitat in order to escape from such dangerous competition. Cultivation of land appears to produce favorable conditions in habitat for both of the families of scorpions. When man plants trees and crops, these attract insects and other animals which the scorpions use as food.

V. CONCLUSIONS

Only two families of scorpions are found in Lebanon, namely the family Scorpionidae and the family Buthidae, but each of them inhabits distinct regions. Members of the family Scorpionidae are relatively small and passive and are commonly found in Central and Western parts of Lebanon. Scorpionids can survive for long periods without food or water, and are cannibalistic. The sexes are distinct. After mating the male is killed and eaten by the female. Female scorpionids give birth to 14-30 young. Scorpionids are very sensitive to light and live in burrows away from it. Individuals of this family cannot withstand laboratory conditions, and live solitary lives both in the laboratory and in nature. The scorpionids' poison is not fatal and comparatively harmless to man.

Members of the family Buthidae are not as common in Lebanon as those of the family Scorpionidae nor as widely distributed. They are large, robust scorpions and are very active. They are found to be almost exclusively localized in the Northern and Eastern parts of Lebanon. They seldom burrow, but live under small rocks. The buthids cannot survive for long periods without having food and water, and are cannibalistic. The males and females are distinct in appearance. After the mating process the female kills and eats the male. Female buthids give birth to relatively few young, generally from 5-12. Buthids are active during both the daylight hours and at night. Although they live

solitary lives in nature, they live in groups under the laboratory conditions and never fight one another, but they exhibit hostility towards the scorpionids. Their poison has a greater effect on man than that of the scorpionids, although it is not fatal.

VI. SUMMARY

1. A study of the scorpions of Lebanon was carried out with emphasis placed on their distribution, ecology and behavior. A collection of 2,063 specimens was made in Lebanon from October 1961 to November 1962.

2. A number of specimens representative of the above collection was sent to Dr. H. L. Stahnke for identification. Three species were identified by him, as Scorpio maurus of the Scorpionidae and Buthotus judaicus, and Buthus acutecarinatus of the Buthidae. Collections were made throughout Lebanon. Both living and dead specimens were brought in for observations and study. The scorpions collected were preserved in 70% ethyl alcohol. Living specimens were kept in glass terraria, and fed small insects such as cockroaches and spiders, where their activities and behavior can be clearly observed.

3. All specimens were examined but only two families were found to live in Lebanon; the families Scorpionidae and Buthidae. Of this collection 1,096 were members of the family Scorpionidae and most of them were mature females with only fifty-two mature males. The remaining 967 specimens belong in the family Buthidae and most of them were mature females with only 98 mature males.

4. The family Scorpionidae is represented by one species, Scorpio maurus. Its chief food consists of spiders and cockroaches, but the females will often eat their young. The sexes are morphologically

separable, and live solitarily in burrows.

5. The family Buthidae is represented by two species, Buthotus judaicus and Buthus acutecarinatus. Both prefer soft-bodied insects as food and are cannibalistic. The females will often eat the male after mating. Individuals of this family are not very responsive to light, and usually do not dig except in the breeding season. Although their poison is not fatal, it is harmful to man.

VII. REFERENCES

- Brues, C., Melander, A.L. and Carpenter, F.M., 1954
Classification of Insects.
Cambridge, Mass., U.S.A.
- Cloudsley-Thompson, J.L., 1955
Some aspects on the biology of Centipedes and scorpions.
Nat. 1955, 174-53
- _____, 1958
Spiders, Scorpions, Centipedes and Mites.
Pergamon Press N.Y., London and Paris.
- Crandall, L., 1913
Poisonous Species in the Insects Collection.
Bull. N.Y. Zool. Soc. 2-16: 1058.
- Fabre, J.H., 1907
Souvenirs Entomologiques.
Ser. 2., Paris.
- Field, H., 1955
Fauna and Flora of Southwestern Asia.
Nat. Hist. 24-28
- Hegner, R., 1936
Parade of the Animal Kingdom.
The Macmillan Co., 112-114.
- Herns, W.B., 1950
Medical Entomology.
The Macmillan Co., N.Y., 595-600

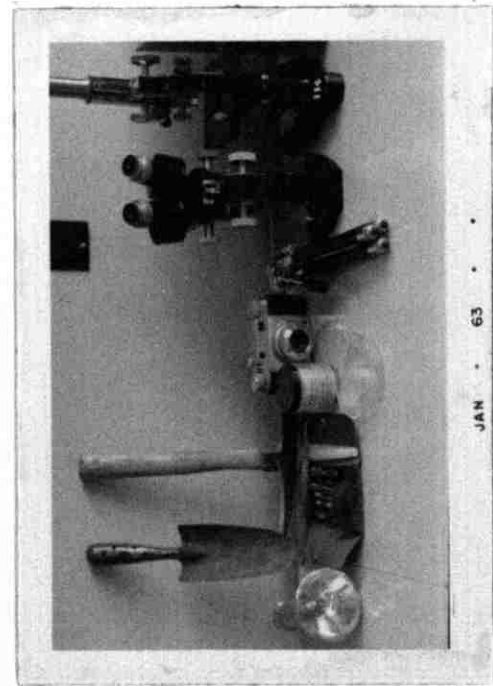
- Lankester, E. R., 1883.
Notes on the habits of the Scorpions Androctonus lunestris
Ehr. and Euscorpium itabicus Roes.
J. Linn. Soc. (Zool.), 16, 455-62
- Pocock, R.I., 1893
Notes upon the habits of some living scorpions.
Nature, Lond., 48, 104-7.
- Savory, T. H., 1935
The Arachnida.
Butler and Tanner Ltd., Frome and London, 1-52.
- Schultze, W., 1927
Biology of large Philippine Forest Scorpion.
Philippine J. Sci., 32, 375-89
- Serfat, A. and Vachon, M., 1950
Quelques remarques sur la biologie d'un scorpion de
l'Afghanistan: Buthotus alticolus (Pocock)
Bull. Mus. Hist. Nat. Paris (2), 22, 215-18.
- Shulov, A. and Amitai, P., 1956
Mating habit in Scorpions
Israel Research Council Bull. Vol. 8, 41-42.
- Shulov, A. Rosin, R. and Amitai, P., 1956
Mating habits in Scorpions.
Israel Research Council, Bull. Vol. 9, 65-69.
- Snodgrass, R.E., 1952
A textbook of Arthropod Anatomy.
Comstock, 59-79.
- Stahnke, H. L., 1938
The Venomous Effects of some Arizona Scorpions.
Sci. 88: 166.

_____. 1945
Scorpions of the Genus Hadrurus Thorell.
Amer. Mus. Nov., No. 1298, 1-9, Pergamon
Press, N.Y.

_____, 1956
Scorpions.
Poisonous animals research laboratory.
Arizona State Univ., 1-36.

Vachon, M., 1953.
The Biology of Scorpions
Endeavour, 12, 80-9

Waterman, J.A., 1950
Scorpions in the West Indies.
Caribbean Med. J. 12, 167-77.



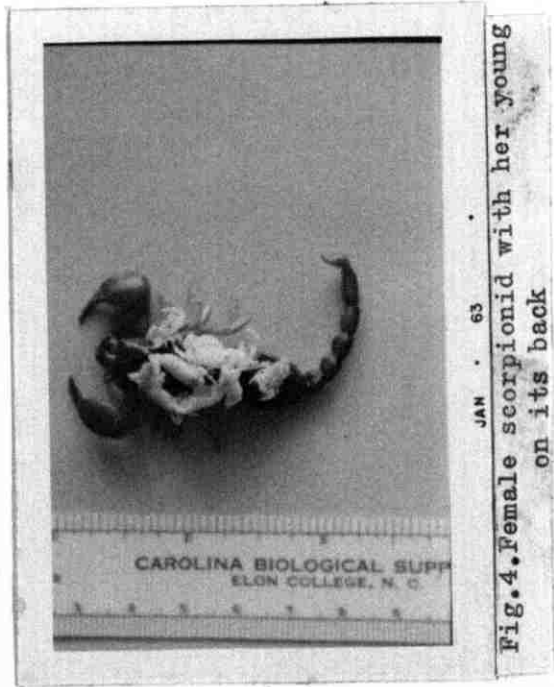
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Fig. 1. Materials That Were Used



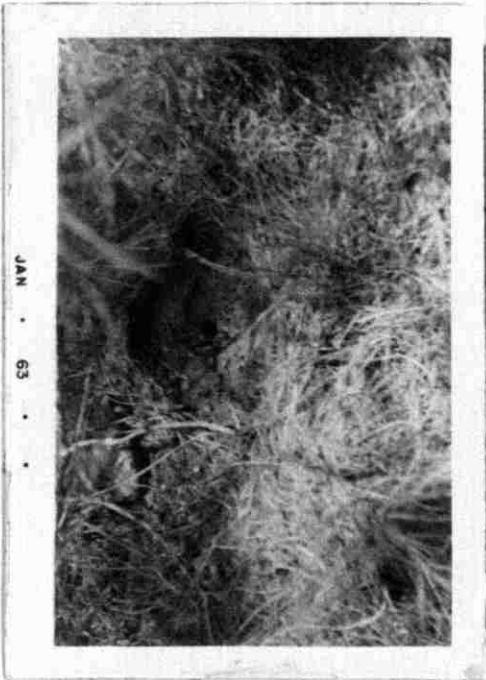
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Fig. 2. A glass box for lab. observations



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Fig. 4. Female scorpionid with her young on its back



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Fig. 3. Burrow of scorpionid at Hnata



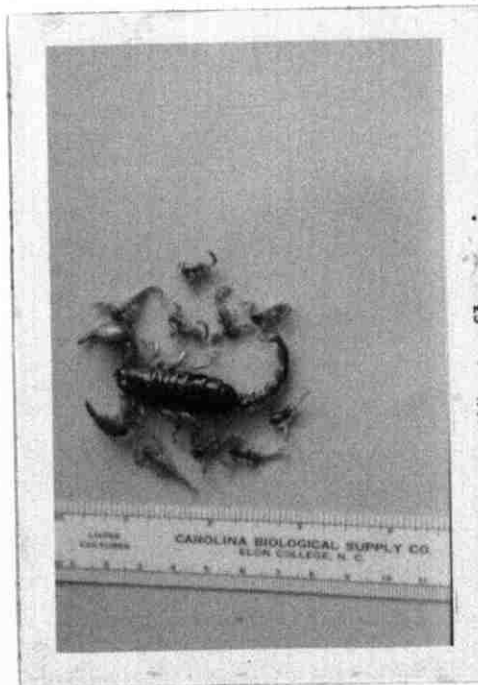
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Fig. 6A. Habitat of buthid at Dar Baachtar



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Fig. 6B. Habitat of scorpionid at Dekwaneh



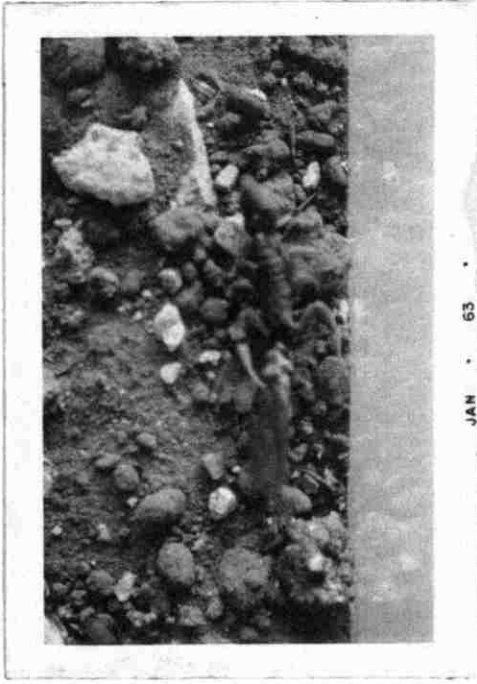
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Fig. 5. Female scorpionid with her young around



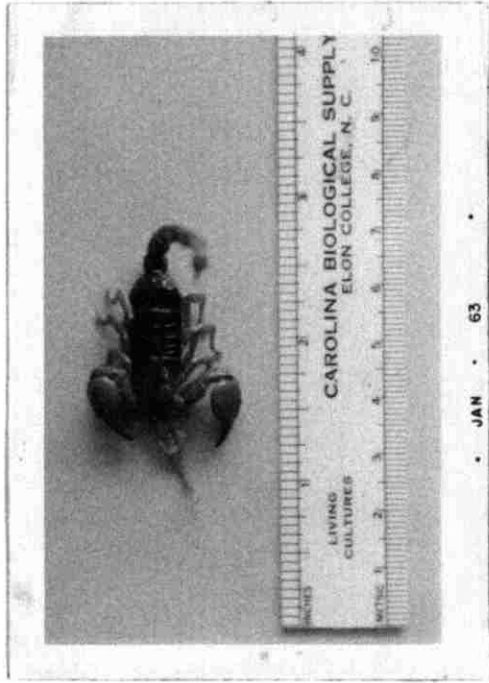
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Fig. 7A. Mating behavior in scorpionids



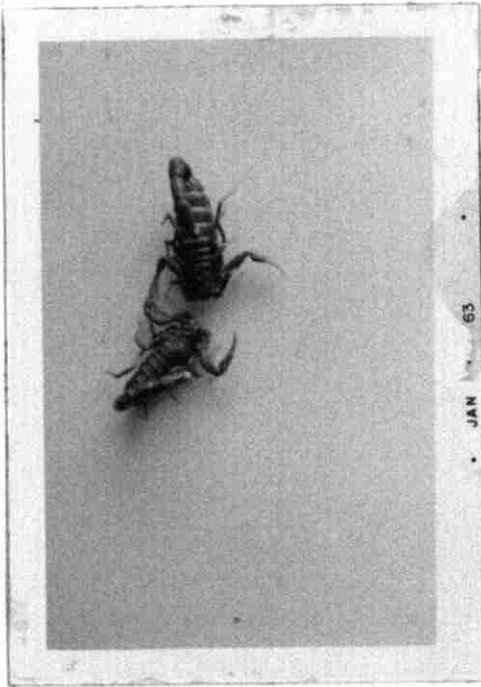
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Fig. 8. Feeding behavior in buthids



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Fig. 9. Cannibalism in scorpionids



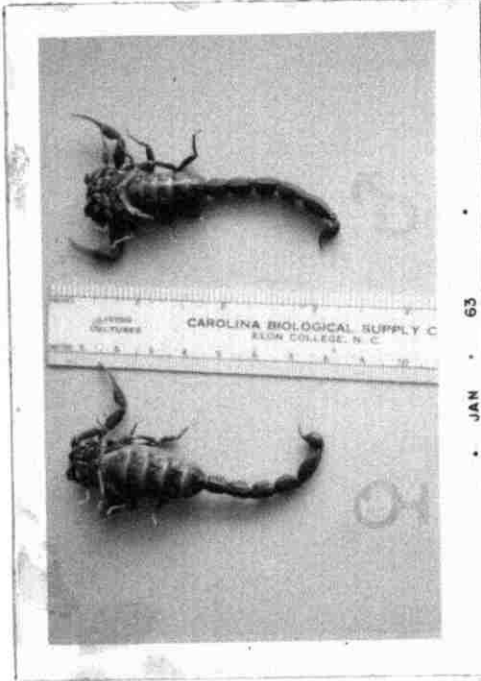
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Fig. 7B. Mating behavior in buthids



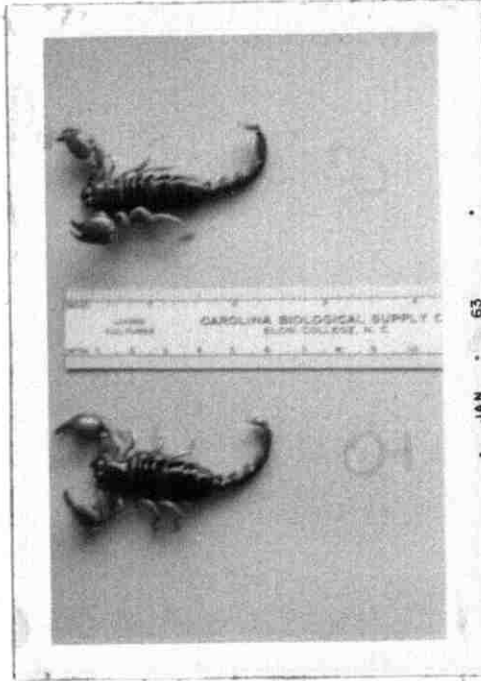
JAN . 63

Fig. 10. Start of fighting between two scorpionids



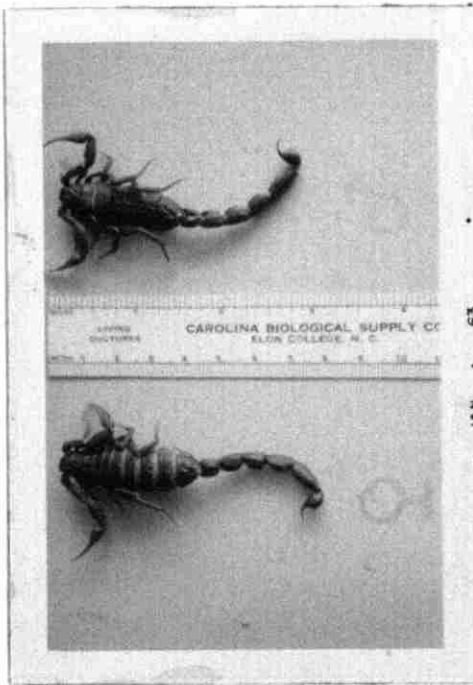
JAN 63

Fig. 11B. Ventral view of male and female buthids



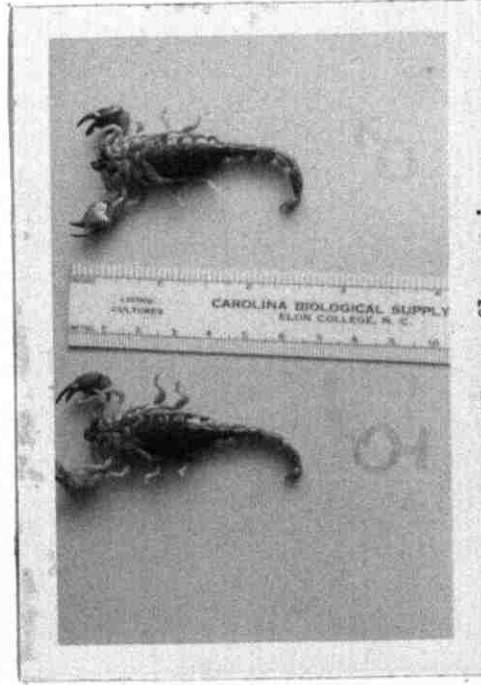
JAN 63

Fig. 12A. Dorsal view of male and female scorpionids



JAN 63

Fig. 11A. Dorsal view of male and female buthids



JAN 63

Fig. 12B. Ventral view of male and female scorpionids

CARTE ROUTIÈRE ET TOURISTIQUE DU LIBAN AU 200.000^E

1/2

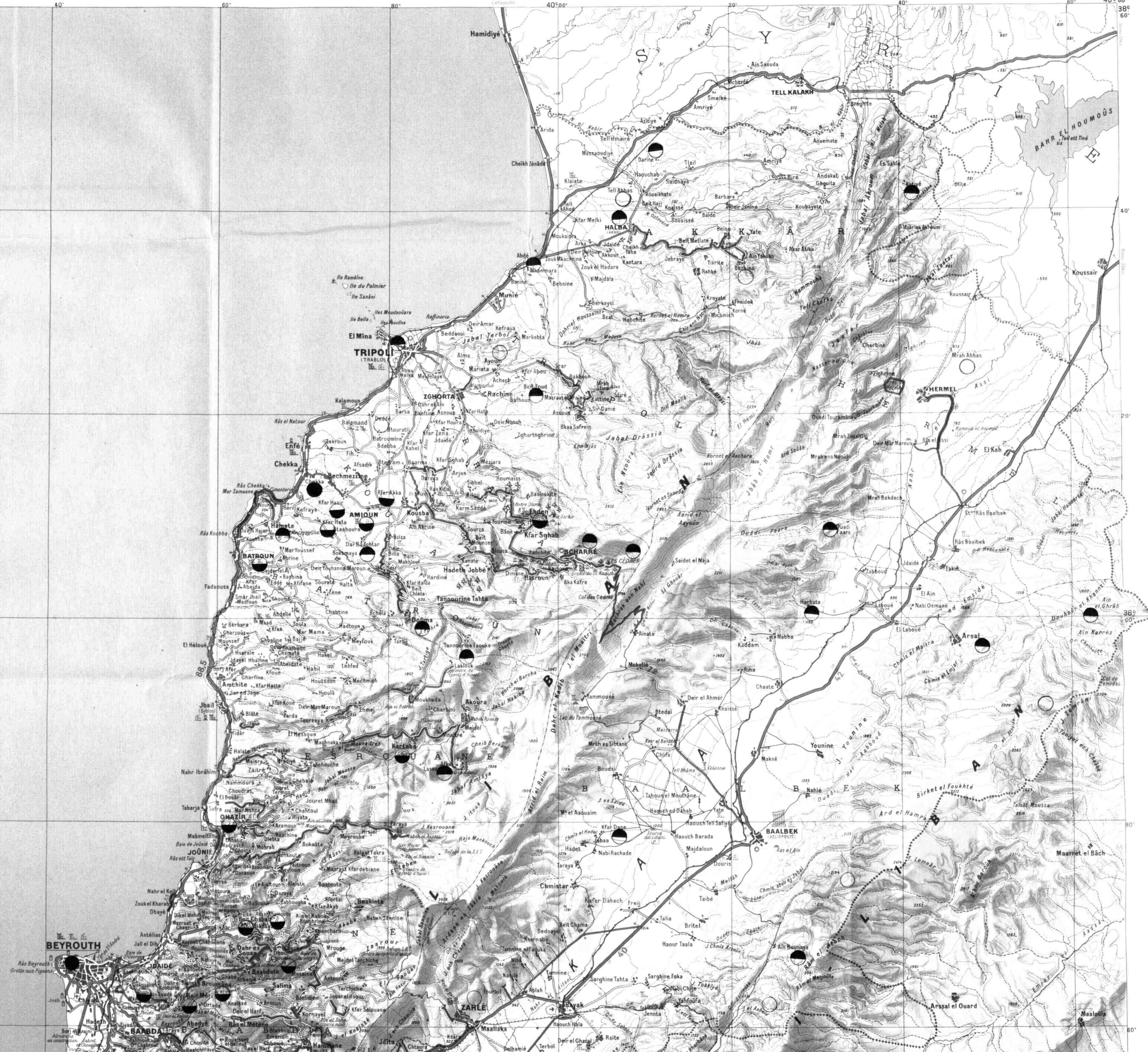
LÉGENDE

- Route asphaltée de 1^{re} classe
- Route asphaltée de 2^{me} classe
- Route asphaltée de 3^{me} classe
- Route à blocage cylindré
- Route macadamisée
- Piste
- Sentier
- Chemin de fer à voie normale
- Chemin de fer à voie étroite
- Rivière, source, puits
- Terrain d'aviation
- Bois
- Limite d'Etat
- Limite de district
- Limite de caza
- Ruine phénicienne
- Ruine romaine
- Ruine arabe
- Ruine croisée
- Monument libanais
- Couvent
- Station balnéaire
- Route pittoresque
- Distances kilométriques
- Capitale
- Chef-lieu de district ou mohafazat
- Chef-lieu de caza
- Localité de plus de 1500 habitants
- Localité de moins de 1500 habitants
- Altitude

BEYROUTH
SAÏDA
BATROÛN
Karaoun
Aïmane

Echelle 1 : 200.000

- NO SCORPIONS
- ◐ FAMILY SCORPIONIDAE
- ◑ FAMILY BUTHIDAE
- BOTH FAMILIES



39° 00'

38° 00'

37° 00'

36° 00'

35° 00'

34° 00'

33° 00'

32° 00'

31° 00'

30° 00'

29° 00'

28° 00'

27° 00'

26° 00'

25° 00'

24° 00'

23° 00'

22° 00'

21° 00'

20° 00'

19° 00'

18° 00'

17° 00'

16° 00'

15° 00'

14° 00'

13° 00'

12° 00'

11° 00'

10° 00'

9° 00'

8° 00'

7° 00'

6° 00'

5° 00'

4° 00'

3° 00'

2° 00'

1° 00'

0° 00'

39° 00'

38° 00'

37° 00'

36° 00'

35° 00'

34° 00'

33° 00'

32° 00'

31° 00'

30° 00'

29° 00'

28° 00'

27° 00'

26° 00'

25° 00'

24° 00'

23° 00'

22° 00'

21° 00'

20° 00'

19° 00'

18° 00'

17° 00'

16° 00'

15° 00'

14° 00'

13° 00'

12° 00'

11° 00'

10° 00'

9° 00'

8° 00'

7° 00'

6° 00'

5° 00'

4° 00'

3° 00'

2° 00'

1° 00'

0° 00'

2/2

