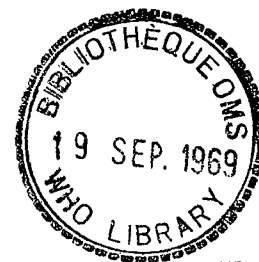




FIELD INVESTIGATION OF AN OUTBREAK OF SMALLPOX  
AT BAWKU, GHANA: MAY-OCTOBER 1967

by

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INDEXED

Eight outbreaks of smallpox with a total of 112 cases, 17 deaths, occurred in Ghana in 1967. In this paper, an outbreak of 66 cases with 10 deaths which took place between May and October in Bawku District in north-eastern Ghana is described. This outbreak is considered of some interest, because it occurred in a rural area of Ghana where implementation of public health measures is a serious challenge. The epidemiological aspects and control measures with their limitations in rural tropical areas will be briefly outlined and discussed as seen by a Medical Officer of Health without special qualifications and training in epidemiology and smallpox eradication.

### Background

Bawku District lies in the north-eastern corner of Ghana. It covers an area of 1227 mi<sup>2</sup> of savannah and has a population of about 180 000. There are four local administrative councils and local authority is normally executed through the Canton Chiefs and village Headmen. There are three major tribes and several minor tribes who live on both sides of the Ghana-Togo border. Apart from Bawku, there are no villages as such; the inhabitants live in small communities in isolated compounds scattered over the district. Each compound consists of a number of mud huts with thatched roofs linked together in a circular form with one entrance opening into a large courtyard which serves as a common sitting place for the members of the family and is also occupied by the domestic animals. The head of the family has a separate compartment while each wife with her children lives in a separate hut independent from the other wives. Markets are held every three days in rotation; prevalent occupations are farming and cattle, sheep and goat rearing. In general the population is poor; malnutrition is not uncommon.

Among the local tribes, smallpox is well known as a deadly disease: the Kusasis and Busangas call it "Naba" which means "the chief of all the other diseases". According to Ministry of Health records, this district experienced 48 cases of smallpox in 1957, eight cases in 1959 and one case in 1960 and none from 1961 until 1967.

### Epidemiology

#### The first outbreak: May-June (Table 1, fig. 1)

After six years absence, smallpox made its first appearance in Bawku District in 1967 with four cases and one death during the months of May and June. The first case (case A-1) an unvaccinated 10-year old boy, living in Bawku itself, became ill on 9 May. His source of infection was not traced and he recovered without sequelae. The second case (case A-2) an unvaccinated girl neighbour and close friend of the first case became ill on 19 May. The third and fourth cases came from the Chief's Compound at Missiga, two miles away. The third case (case A-3) was a three-year old unvaccinated boy who died on 8 June at Bawku Hospital

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with a diagnosis of "chickenpox and severe toxoemia". His source of infection was not determined. On the day of his death his mother, (case A-4), also unvaccinated, became ill with smallpox.

The second outbreak: August-October (Table 1, fig. 1)

After a period of five weeks without cases, two deaths due to smallpox occurred at Sugudi, a locality about 10 miles from Bawku.

The first two cases were elderly women whose source of infection could not be traced apart from the fact that they were regular visitors of Widana Market, an important international market held every three days. It is a place of meeting for people coming from the nearby villages of Ghana, Togo and Upper Volta. Widana is about 5 miles from Sugudi where the second outbreak of smallpox started at the end of July. The first two cases became ill on 27 July and died on 4 and 5 August, respectively. From the description of the disease obtained from their husbands and neighbours, there was no question about the diagnosis.

Additional field investigation of these and other cases confirmed the initial impression that the disease might have been imported into Bawku District from either Togo or Upper Volta where smallpox was endemic. Modified or mild ambulant cases often misdiagnosed as chickenpox, coming to visit Widana Market might have easily transmitted the disease. The level of immunity in the population is notoriously low in this area because of difficulties in conducting vaccination programmes.

To determine if the disease might have been imported from either of the two neighbouring countries, the author conducted additional investigations in Upper Volta and Togo. In Togo the nurses in charge of two dispensaries denied any knowledge of recent cases. The senior nurse of Dapango Hospital said that no patient suffering from smallpox had been seen during the last four or five years. Equally disappointing was the search at Bungane, the first village beyond the boundary in Upper Volta. However, health personnel and customs officers admitted that mass vaccination had been carried out in the past few months in the area. Additional supportive evidence that Widana market was the original source comes from the history of other cases. Case 22 was a one-year old daughter of an escort police constable, stationed at Pulimakon Police Barracks, situated less than half a mile from Widana Market. The parents denied any contact with other cases; in fact, they belong to the Dagarti tribe from north-western Ghana and had few contacts with other villagers. The mother admitted, however, having taken her daughter regularly to Widana Market before she got sick. Although the child had never been vaccinated, the mother had been vaccinated on several occasions during her stay in other stations with the husband.

Following the first two fatal cases at Sugudi, two daughters (cases 3 and 4) of one of the women became ill and case 3, in turn, infected her son (51). A close neighbour (5) of one of the two original cases became ill and infected her daughter (6). In summary, there were seven cases and three deaths at Sugudi among 56 persons.

Later, the infection travelled from Sugudi to Zongo Natinga, situated a few miles away. At Zongo Natinga the author detected 16 cases, one death among 448 persons. The Zongo Natinga outbreak can be divided into two sub-groups; one of three cases among those living in two compounds north of the main road and a group of 13 cases, one death, living in five compounds south of the main road. In the first sub-group, the grand-daughter (9) of case 2 from Sugudi contracted infection from her and subsequently infected her sister-in-law (20) living in the same compound. One case (46), which occurred 15 days later denied any relation with other local cases and may have contracted infection at the Widana Market. The second sub-group began with a case in a 50-year old man (7) who visited the compound at Sugudi on several occasions where the first two cases had died. In the compound of case 7, cases occurred among his daughter (13), grand-child (23), wife (24) and mother (12) the latter of whom died.

The initial case in this group, case 7, was visited by a 50 year-old neighbour (8) who in turn infected her two grand-children (17,18) living with her and they, in turn, infected a third grandchild (54) in this same compound. Infection occurred in two other compounds after visits to the original case. In one, a 33-year old woman (16) infected her daughter (25) and she, in turn, a one year-old child (52) in the compound.

The next crop of smallpox cases occurred at Cosi, about two miles by path from Zongo Natinga. The source of infection for these cases was the index case, case 7, at Zongo Natinga. At Cosi, there were five infected compounds with a total of 10 cases, one death among 539 persons. In the first compound the importer of the virus was a 16 year-old boy (14) who visited on several occasions his friend case 7 at Zongo Natinga before getting sick. The boy, in turn, was the source of infection for his father (26), his uncle (43) and his mother (42), the last of whom died. In a nearby compound, the sister-in-law (45) of the dead woman became ill and, in turn, infected her son (53). In the remaining three infected compounds, the first cases (10,11 and 15) all had visited their common friend case 7 in his house at Zongo Natinga during his illness. On a subsequent visit, it was found that the mother (44) of case 10 had also developed smallpox.

From Zongo Natinga the virus moved southwards to Sabzundi and Karatesi. At Sabzundi, about four miles from Zongo Natinga, the author saw only one case (19) among 63 persons; this person had also visited case 7 at Zongo Natinga during his illness and had taken part in the funeral of the mother of case 7 (12).

At Karatesi, two miles south of Sabzundi, 22 cases, two deaths occurred among 433 persons. The first case of smallpox at Karatesi was in a 40-year old man (27) who also visited case 7 in his house at Zongo Natinga. He became ill on 5 September and died one week later. Nine other cases occurred in the compound including his sister-in-law (30), nephew (57), daughter (32), another sister-in-law (49), two nephews (33,34), two nieces (36,48) and son (62). In a second compound the brothers (28,31) of case 27, the index case in the village, developed smallpox at the same time, followed a few days later by the mother of case 27. In this same compound during the last week of October, a new-born baby son (58) of one of the brothers (28) became the final victim of the outbreak of smallpox in Bawku District. His mother had been vaccinated during the last week of pregnancy together with all other contacts. Seven days later this woman delivered a full-term healthy baby, who 12 days later developed fever and rash typical of smallpox and died on his fourteenth day of life. This unlucky child was the only susceptible left after vaccination of family contacts because on the day of vaccination he was still unborn. Inside the third compound, the author found that the brother-in-law (35) of case 27, the index case, had developed smallpox. He eventually infected his sister (59) and his brother (50). In the fourth compound, the index case (38) had become infected through a visit to case 27 and he in turn transferred the infection to his two brothers (60,61). In the fifth compound, there was only one case (29), the nephew of case 27. Finally, in the sixth compound, a neighbour (55) of the originally infected compound in the village developed smallpox. She had frequently visited the compound.

Additional cases of smallpox were seen in three other localities within Bawku District but investigation failed to demonstrate their source of infection. One case (47) occurred at Kugasego, a few miles south-west of Karatesi; 331 contacts were vaccinated. The second locality was Morgu, in which three cases, two deaths occurred in one compound. The first case was a one-year old baby (39) who became ill on 9 September and died one week later. She in turn infected her mother (40) and her brother (41), a four-year old child who died of septic complications and marasmus on the eighteenth day; 749 contacts were vaccinated at Morgu. The third locality was Deega, four miles south-east of Bawku, in which one case (56) was detected and 97 contacts were vaccinated.

#### Age distribution and vaccination status of patients

Over half of the cases occurred among adults; males and females were about equally afflicted (Table 2).

Of the total of 66 cases, 29 (44 per cent.) gave a history of past vaccination but whether the vaccination was successful or not was not determined as no examination was made for vaccination scars. Notably, however, 27 of the 29 were more than 20 years old and most had not been vaccinated since infancy. Deaths occurred primarily in the old and the very young. Among 14 cases under 4 years of age, four (29 per cent.) died and among 11 cases over 50 years of age, four (36 per cent.) died.

#### Laboratory

Confirmation of the diagnosis was primarily by clinical impression. Most cases were wholly typical and posed few problems in diagnosis. In three cases (17,18,22), the virus was isolated on chorioallantoic membrane and high HAI titres were obtained in convalescent sera.

#### Summary of outbreak and control measures

The epidemic curve of the outbreak as a whole (fig. 2) shows a steady increase in cases beginning in August and reaching a peak in mid-September.

During the outbreak routine control measures were carried out more or less in the traditional fashion by local health staff with assistance from the Investigation Unit of the Ministry of Health and the Smallpox-Measles Programme. These measures are briefly described to elucidate some of the problems in tropical rural areas.

The first information about the occurrence of smallpox in the District was brought to the attention of the Health Inspector at Bawku from the Chief in charge of the affected areas through the Sanitary Headman, stationed at Pusiga. The Health Inspector, by borrowing the hospital ambulance, the only means of transport at his disposal, visited the reported cases in their compounds. By questioning these cases and through investigation, he discovered additional cases. He informed by telegram the Regional Medical Officer of Health at Bolgatanga, Headquarters of the Upper Region. The Regional MOH inspected the infected compounds, confirmed the diagnosis and sent a cable to the Senior Medical Officer, Epidemiological Division, Ministry of Health, Accra. The author, as director of the smallpox eradication programme was asked to investigate the outbreak and to co-ordinate control measures. He was assisted by two United States Public Health Service technical advisers assigned for the smallpox eradication and measles control programme. Each of the infected areas was visited on several occasions by the author and his colleagues during the months of September and October. The search for cases was a very rewarding experience; what was at the beginning only a daily collection of piece-meal information emerged gradually as a comprehensive picture of the outbreak.

Some of the patients were admitted in the isolation ward of Bawku Hospital and treated there; others were isolated in groups not far from their compounds and given supportive treatment during the visits of the investigating team. There was no doubt that semi-domiciliary isolation was of little value for the protection of contacts, considering the lack of supervision, the particular type of housing and the close family ties of the population.

There were 2708 contacts of cases, 500 of whom were members of the immediate and extended family and the remainder of whom were neighbourhood contacts. Due to the distances and lack of transport and staff, surveillance of contacts was impossible.

At the time the author arrived, a total of 16 877 vaccinations had been performed by the local health staff and itinerant Rural Health Services personnel during the period August-September both in infected areas and in nearby markets. A rapid survey was undertaken to assess the efficacy of this measure. A large number of recently vaccinated persons was examined at random in markets, schools, on the roads and in and around infected compounds. A high proportion of "takes" was noted amongst primary vaccinations but most of the

revaccinees showed no take. It was suspected that the vaccine had lost potency probably because of poor storage facilities. It was therefore decided to undertake mass vaccination of the entire District employing ped-o-jets. The vaccine employed had been handled with great care and had always been kept under refrigeration. Between the last week of September and the first week of November, 165 449 persons were vaccinated. Multiple puncture vaccination, again using properly preserved vaccine, was performed among the 2708 contacts of cases by a team of local vaccinators under direct supervision of the author. These contacts had been vaccinated shortly before with the low potency vaccine by local health staff but with poor take rates; the take rate when this group was revaccinated with good vaccine was very high. From fig. 1 it would appear that the vaccination activities produced a cut off in the evolution of the outbreak. Although mass vaccination was performed to improve the immunity level throughout the District, it is believed that the programme of vaccination of contacts was the primary factor in abruptly terminating spread. From the epidemiological pattern of spread of cases, it is clear that most cases occurred as a result of contact infection in the household. Thus prompt focal and perifocal immunization, concentrated among the family and neighbourhood contacts of index cases, is the most economical, rational and effective approach to outbreak control in tropical rural areas.

Practices which have developed with respect to disinfection for smallpox are basically empiric. (Manual of smallpox eradication, WHO, 1967). Formaldehyde disinfection was applied at Bawku for the disinfection of bedrooms, huts, compounds and hospital wards. A 40 per cent. solution of formaldehyde in water, containing 10 per cent. methanol to avoid polymerization was sprayed inside the rooms by a special fogging machine operated by a motor. In the opinion of the author, disinfection did little except to produce a noxious odour and weeping eyes.

TABLE 1. CASES OF SMALLPOX, BAWKU DISTRICT, GHANA, MAY-OCTOBER 1967

Case	Sex	Age	Onset	Vaccination history	Probable source of infection	Remarks
1	F	55	25/7	?	Widana Market	Died on 4/8
2	F	60	25/7	Yes (infancy)	Widana Market	Died on 5/8. Mother of cases 3 and 4; Grandmother of case 9
3	F	40	4/8	Yes	Case 2	Daughter of case 2; mother of case 51
4	F	48	17/8	Yes (infancy)	Case 2	Daughter of case 2; mother of case 9
5	F	46	19/8	Yes	Case 1 or 2	Neighbour of cases 1 and 2; mother of case 6
6	M	28	25/8	0	Case 5	Son of case 5. Died on 2/9
7	M	50	7/8	Yes (infancy)	Case 1 or 2	Visited cases 1 and 2
8	F	50	26/8	Yes	Case 7	Visited case 7; grandmother of cases 17 and 18
9	F	12	20/8	0	Case 2	Visited case 2 her grandmother
10	M	21	26/8	0	Case 7	Visited case 7
11	M	20	27/8	0	Case 7	Visited case 7
12	F	60	27/8	Yes (infancy)	Case 7	Mother of case 7. Died on 6/9
13	F	21	28/8	0	Case 7	Daughter of case 7
14	M	16	29/8	0	Case 7	Visited case 7
15	M	56	1/9	Yes (infancy)	Case 7	Visited case 7
16	F	33	1/9	Yes	Case 7	Visited case 7; mother of case 25
17	F	1	3/9	0	Case 8	Granddaughter of case 8; a twin of case 18
18	F	1	5/9	0	Case 8	Granddaughter of case 8; a twin of case 17
19	M	18	7/9	0	Case 7	Visited case 7
20	F	16	13/9	0	Case 9	Sister-in-law of case 9

TABLE 1. CASES OF SMALLPOX, BAWKU DISTRICT, GHANA, MAY-OCTOBER 1967 (continued)

Case	Sex	Age	Onset	Vaccination history	Probable source of infection	Remarks
21	F	40	13/9	Yes	Case 7	Visited case 7
22	F	1	14/9	0	Widana Market	Visited Widana Market with her mother
23	M	1	14/9	0	Case 13	Grandchild of case 7; son of case 13
24	F	40	14/9	Yes	Case 7 or 13	Wife of case 7; mother of case 13
25	F	3/12	15/9	0	Case 16	Daughter of case 16
26	M	60	17/9	0	Case 14	Father of case 14
27	M	40	5/9	Yes (infancy)	Case 7	Visited case 7. Died on 14/9
28	M	40	19/9	Yes (infancy)	Case 27	Brother of case 27
29	M	26	19/9	Yes	Case 27	Nephew of case 27
30	F	30	20/9	Yes (infancy)	Case 27	Sister-in-law of case 27
31	M	33	19/9	Yes	Case 27	Brother of case 27
32	F	3	21/9	Yes	Case 27	Daughter of case 27
33	M	35	21/9	Yes (infancy)	Case 27	Nephew of case 27
34	M	2	21/9	0	Case 27	Nephew of case 27
35	M	17	22/9	0	Case 27	Brother-in-law of case 27
36	F	5	22/9	0	Case 27	Niece of case 27
37	F	60	21/9	Yes	Case 27	Mother of case 27
38	M	12	21/9	0	Case 27	Visited compound of case 27
39	F	1	9/9	0	?	Died on 17/9
40	F	30	22/9	Yes	Case 39	Mother of cases 39 and 41
41	M	4	23/9	0	Case 39	Son of case 40. Died on 12/10
42	F	55	11/9	?	Case 14	Mother of case 14. Died on 18/9

TABLE 1. CASES OF SMALLPOX, BAWKU DISTRICT, GHANA, MAY-OCTOBER 1967 (continued)

Case	Sex	Age	Onset	Vaccination history	Probable source of infection	Remarks
43	M	65	15/9	Yes	Case 14	Uncle of case 14; brother of case 26
44	F	48	20/9	Yes (infancy)	Case 10	Mother of case 10
45	F	40	25/9	0	Case 42	Sister-in-law of case 42
46	F	30	28/9	Yes (infancy)	? Widana Market	Visited Widana Market
47	M	40	19/9	Yes	?	-
48	F	5	4/10	0	Cases 30-32-33 34-36	Niece of case 27
49	F	35	4/10	Yes (infancy)	Cases 30-32-33 34-36	Sister-in-law of case 27
50	M	6	5/10	0	Case 35	Brother of case 35
51	M	20	21/9	Yes	Case 3	Son of case 3
52	M	1	6/10	0	Case 25	-
53	M	6	5/10	0	Case 45	Son of case 45
54	F	3	7/10	Yes	Cases 17 and 18	Sister of cases 17 and 18; grandchild of case 8
55	F	35	7/10	Twice	Cases 30-32-33 34-36	Neighbour
56	F	50	6/10	Yes (infancy)	?	-
57	M	8	8/10	0	Cases 30-32-33 34-36	Nephew of case 27
58	M	12 days	21/10	0	Cases 28-31-37	Son of case 28. Died on 27/10
59	F	12	7/10	0	Case 35	Sister of case 35
60	M	10	7/10	0	Case 38	Brother of case 38
61	M	4	8/10	0	Case 38	Brother of cases 38 and 60
62	M	10	8/10	0	Cases 30-32-33 34-36	Son of case 27
A-1	M	10	9/5	0	?	



TABLE 1. CASES OF SMALLPOX, BAWKU DISTRICT, GHANA, MAY-OCTOBER 1967 (continued)

Case	Sex	Age	Onset	Vaccination history	Probable source of infection	Remarks
A-2	F	10	19/5	0	Case A-1	Neighbour of case A-1
A-3	M	3	?	0	?	Died on 8 June with "chickenpox". Son of case A-4
A-4	F	30	8/6	0	Case A-3	Mother of case A-3

TABLE 2. AGE DISTRIBUTION AND VACCINATION STATUS OF PATIENTS

Age	Total cases	Previously vaccinated	No history of vaccination	Unknown
<1	2 (1)	0	0 (1)	
1-4	12 (3)	2	10 (3)	
5-9	5	0	5	
10-19	11	0	11	
20-29	6 (1)	2	4 (1)	
30-39	9	8	1	
40-49	10 (1)	9 (1)	1	
50+	11 (4)	8 (2)	1	2 (2)
	66 (10)	29 (3)	35 (5)	2 (2)

Summary

This paper deals with the field investigation of an outbreak of smallpox which occurred in the Upper Region of Ghana in 1967 and caused 67 cases and 10 deaths. The epidemiological aspects, the clinical and laboratory diagnosis together with the control measures are briefly outlined and discussed without claim of scientific perfection; these notes are a modest essay presented by a Medical Officer of Health working in the Tropics far from the academic centres.

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Fig. 1. Spread of Smallpox - Bawku District, Ghana - May-Oct. 1967.

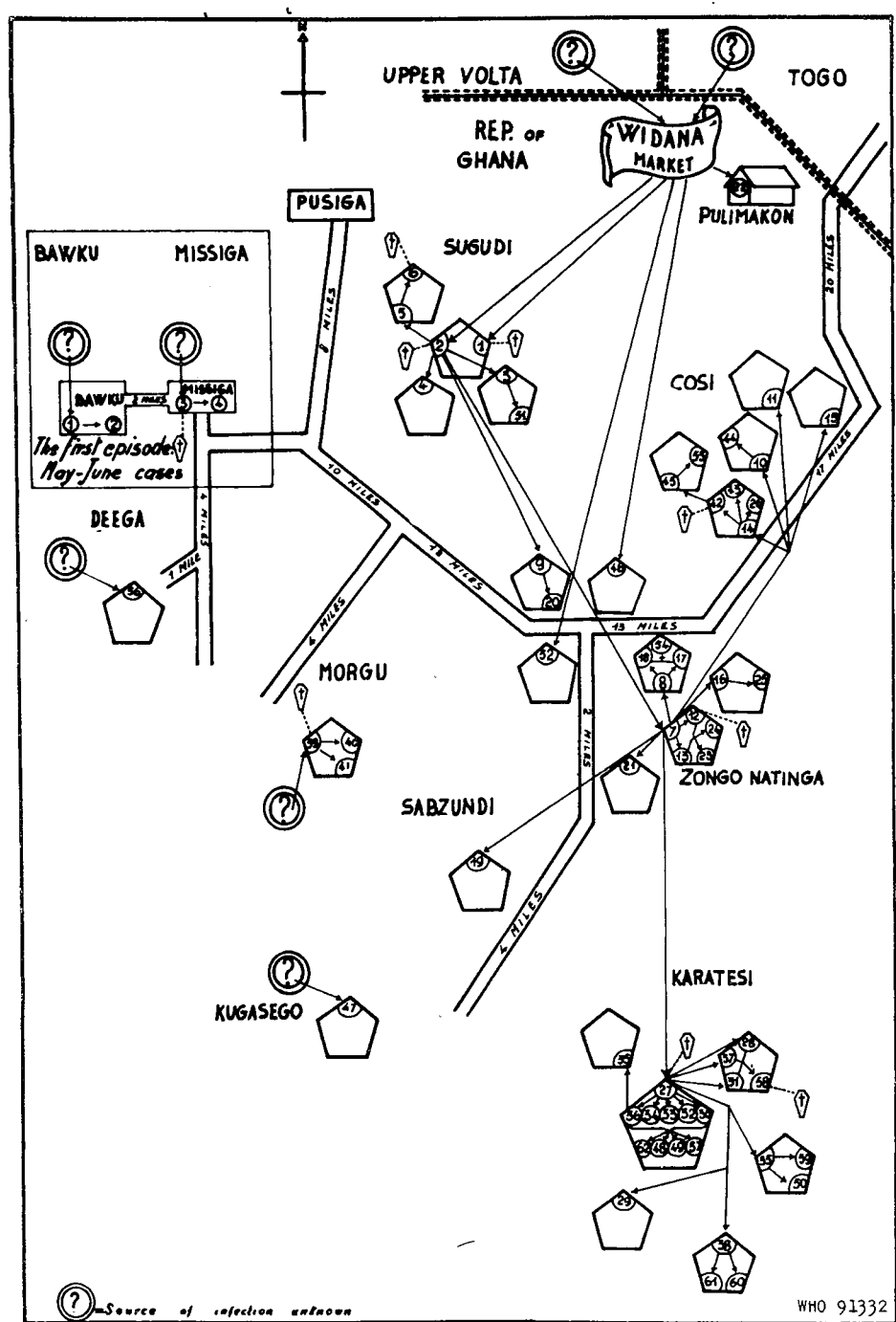


FIG. 2 CASES AND DEATHS BY WEEK -  
BAWKU DISTRICT; GHANA - MAY TO OCTOBER, 1967

