

ONCHOCERCIASIS CONTROL PROGRAMME
IN THE VOLTA RIVER BASIN AREA

PROGRESS REPORT OF THE WORLD HEALTH ORGANIZATION FOR 1980

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SUMMARY

Highlights of 1980 were:

- spectacular results in the third passage epidemiological evaluation in the west Upper Volta area of Phase I where the incidence of the disease was nil in all age-groups examined;
- a successful field trial with a second formulation of Abate insecticide which proved as effective and as acceptable as the Procida product thus giving OCP two sources of supply and greater flexibility for purchasing;
- a reduction in susceptibility to Abate in an isolated population of one species of the S. damnosum complex, in a forest area on the lower Bandama in Ivory Coast;
- the launching of a new programme of training and research in health economics; 12 participants attended the first summer seminar and 24 candidates have been put forward so far for fellowships;
- the constitution of the Expert Advisory Committee¹ and of the Ecological Group which held their first meetings in Geneva in September;
- presentation by the Independent Commission of its interim report on the long-term prospects.

Of particular note were:

- the visit of His Excellency General El Hadj Aboubakar Sangoulé Lamizana, President of Upper Volta to OCP on 1 and 2 September. The programme arranged included a briefing, film show and field visits;
- recognition of the work of OCP staff members Drs J. B. Davies and J. F. Walsh who, together with Dr R. Garms of the Bernhard-Nocht Institute, Hamburg, were awarded the City of Dusseldorf Hygiene Prize for 1980.

Expenditures for 1980 are now estimated at \$ 15 432 483.

INSECTICIDE CONSUMPTION
FLIGHT HOURS AND EPIDEMIOLOGICAL EVALUATIONS: 1974-1979

| | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | Total |
|-----------------------------|------|--------|---------|---------|---------|----------------------|---------|
| Litres/insecticide | | 75 631 | 129 947 | 155 615 | 215 879 | 263 377 ² | 840 449 |
| Helicopter hours | | 2 783 | 4 265 | 5 358 | 5 286 | 5 504 | 23 196 |
| Fixed-wing hours | | 541 | 614 | 1 025 | 1 204 | 1 371 | 4 755 |
| No. villages examined (EPI) | | 75 | 122 | 107 | 80 | 71 | 455 |
| No. persons examined (EPI) | | 18 712 | 30 726 | 25 943 | 20 944 | 19 086 | 115 411 |

¹ List of members - Annex I.

² The 20% increase in insecticide consumption in 1979 is accounted for by the extension of control operations in Ivory Coast.

VECTOR CONTROL

1. Vector control operations in 1980 covered a total ground area of 764 000 km² and 18 034 km of river per treatment cycle in the wet season, and 8014 km per treatment cycle in the dry season. Requirements of insecticide for 1980 were estimated at 270 000 litres and flight hours at 5960.

FLIGHT HOURS AND ABATE CONSUMPTION
JANUARY 1979-SEPTEMBER 1980

| Month | Helicopter | | Fixed-wing | | Abate | |
|-----------|------------|---------|------------|-------|-----------|-----------|
| | 1979 | 1980 | 1979 | 1980 | 1979 | 1980 |
| January | 428.1 | 483.0 | 80.2 | 80.0 | 11 451.7 | 17 211.5 |
| February | 317.7 | 372.6 | 67.8 | 59.3 | 5 785.8 | 11 558.0 |
| March | 286.0 | 359.9 | 44.9 | 48.4 | 6 003.4 | 8 574.8 |
| April | 305.9 | 421.3 | 53.4 | 41.7 | 6 617.9 | 9 678.7 |
| May | 579.4 | 415.3 | 89.6 | 34.0 | 16 088.6 | 10 795.0 |
| June | 535.4 | 530.0 | 90.6 | 57.4 | 25 727.6 | 17 479.3 |
| July | 526.5 | 695.9 | 138.7 | 131.6 | 30 756.6 | 23 883.0 |
| August | 581.7 | 459.1 | 192.7 | 115.1 | 45 935.7 | 17 485.0 |
| September | 483.3 | 441.3 | 142.5 | 130.1 | 34 342.7 | 20 631.6 |
| Total | 4 044.0 | 4 178.4 | 900.4 | 697.6 | 182 710.0 | 137 296.9 |

2. From 1 January experimental interruption of insecticide treatment was undertaken on all rivers in Phase I with the exception of the Bou, the Banifing IV and the Black Volta and its tributaries south of Batie. It was planned to resume treatment only when one nulliparous Simulium was caught, or when catches reached 10 flies a day.

3. In all, treatments stopped for eight weeks on the Upper Comoé and the Black Volta upstream from Samendeni, and for 13 weeks on the Lotio river near Sikasso and the Comoé river between the tributaries of Kolonko and Kinkene. Treatments were periodically interrupted for a total of nine weeks on the White Bandama.

4. Excellent results in Phase II with zero fly catches in many parts enabled treatments to be suspended throughout most of this phase in August and September. Only short stretches of the Sissili, Red Volta and Upper White Volta remained under treatment.

5. Flooded rivers throughout most of the Programme area in August and September resulted in the disappearance of many breeding sites normally present at lower water levels. In consequence a number of these rivers were left untreated. The Oti, the White Volta, parts of the Black Volta, the Baoulé and Bagoé were so affected and at end September were still omitted from treatment circuits.

Aerial contract

6. The second aerial spraying contract terminated on 31 December 1979. The third contract started on 1 January 1980 with the same contractor, the Canadian Commercial Corporation/Viking Helicopters Ltd., and will continue for three years. Under the terms of the new contract there is a basic requirement for six helicopters and one fixed-wing aircraft, the Programme having the possibility of calling in additional aircraft for rainy season operations at one month's notice. From 1 June seven helicopters and two fixed-wing aircraft were in operation. The main operating bases continue to be Bobo-Dioulasso and Tamale.

7. As a result of experience gained so far certain modifications to the aircraft and spraying equipment were required under the new contract. These included improved ventilation, installation of partitions in the helicopter to isolate insecticide fumes to the rear of the cabin, positioning of new external mirrors to enable insecticide application to be viewed more easily, addition of tropical mesh seats for pilots and passengers, and new radios to improve communications. Specifications for the application equipment were changed to provide more flexibility in distribution of insecticide. Riverine discharge varies widely between dry and rainy seasons and the new equipment, by offering flexibility in insecticide dosage and flow rate, should enable all conditions of river to be effectively treated.

8. Contract review meetings between CCC/Viking and OCP were held in Ouagadougou from 13 to 19 February, and in Ottawa from 18 to 22 August. Progress towards the modifications stipulated was noted including the installation of a new HF radio system to improve communications between Bobo-Dioulasso and Ottawa. OCP, for its part, had located and marked 15 power lines in Ivory Coast to reduce flying hazards. The spraying equipment was discussed in detail including the need for a system suitable for both Chlorphoxim and Abate. It was agreed to test a stainless steel tank in a treatment helicopter.

9. The next contract review meeting has been scheduled for the last week of October 1980 in Ouagadougou.

Entomological evaluation

10. Six sectors and 25 subsectors, including 77 vector collecting teams were involved in the entomological evaluation which covered some 375 catching sites.

11. The periodic rotation of "Sector Chiefs", which is intended to provide as broad an experience and knowledge of the Programme area as possible, took place during the course of the year.

12. The first four months of 1980 followed the same pattern as in 1979, with zero catches of S. damnosum at most sites in the Programme area. In March, for example, only 74 flies were caught in 223 days of catching, with the majority of these occurring along the southern boundary. As before, a few sites on the rivers Kulpawn, White Volta and Oti presented difficulties but were finally brought under control. In the west, results were particularly encouraging and flies were recorded on the Léraba, Bougouriba and Bandama rivers only after treatments had been deliberately interrupted for several weeks.

13. For the wet season up to the end of July the results in Phases I and II can be considered satisfactory. No catching points registered an Annual Transmission Potential (ATP) of more than 200. On the River Léraba, densities were higher than in 1979, probably due to a higher overall level of reinvasion, but even so the cumulative monthly transmission potential for this point reached only 177 by the end of August, compared with 1122 in 1976, and it is unlikely to climb much higher.

14. In Phase III W reinvasion was particularly heavy with twice as many flies as in 1979 being recorded at Madina Diassa. A similar situation was observed along most of the western edge of the Programme. In Phase III E as before, the sub-sectors of Dapaon, Natitingou and Niamey showed excellent results, and it was only to the east of Kandi, along the river Sota, that fly densities were persistently unsatisfactory. In the area of Lama-Kara very good results were recorded up to the period of reinvasion, which started in June, and even then levels of biting flies were lower than in previous years possibly due to the experimental treatments to the south.

COMPARISON OF FLY CATCHES - 1975-1979
FLIES PER MAN PER DAY

| Léraba River - Pont Routier | | | | | |
|------------------------------|-----|------|------|--------|-----------|
| | May | June | July | August | September |
| 1975 | 92 | 115 | 151 | 114 | 69 |
| 1976 | 141 | 129 | 103 | 86 | 54 |
| 1977 | 26 | 134 | 60 | 6 | 1 |
| 1978 | 50 | 39 | 33 | 2 | 1 |
| 1979 | 2 | 6 | 4 | 4 | 1 |
| 1980 | 9 | 18 | 19 | 1 | <1 |
| Bandama River - Bema | | | | | |
| 1975 | 57 | 94 | 182 | 116 | 35 |
| 1976 | 56 | 68 | 40 | 34 | 14 |
| 1977 | 6 | 82 | 12 | 3 | 2 |
| 1978 | 33 | 18 | 7 | 2 | 1 |
| 1979 | 3 | 1 | <1 | <1 | <1 |
| 1980 | 1 | <1 | 0 | <1 | 6 |
| Bou River - Gite 3 | | | | | |
| 1975 | 153 | 270 | 344 | - | - |
| 1976 | 219 | 170 | 104 | 112 | 66 |
| 1977 | 48 | 256 | 58 | 15 | 17 |
| 1978 | 108 | 33 | 21 | 11 | 32 |
| 1979 | 6 | 10 | 5 | 5 | 7 |
| 1980 | 4 | 5 | 11 | 3 | 20 |
| Comoe River - Kafolo | | | | | |
| 1975 | 15 | 41 | 15 | 34 | 2 |
| 1976 | 6 | 8 | 11 | 7 | 4 |
| 1977 | 3 | 32 | 11 | 2 | <1 |
| 1978 | 5 | 9 | 39 | 10 | 2 |
| 1979 | 0 | 0 | <1 | 1 | <1 |
| 1980 | <1 | 0 | 0 | <1 | <1 |
| Marahoué River - Gite Mermis | | | | | |
| 1976 | 341 | 316 | 331 | 271 | 343 |
| 1977 | - | 325 | 121 | 25 | 61 |
| 1978 | 280 | 315 | 224 | 88 | 44 |
| 1979 | 18 | 9 | 10 | 5 | 1 |
| 1980 | 21 | 2 | 5 | 14 | 9 |

Reinvasion

15. A team of five consultants was recruited for the reinvasion studies which this year were divided into four activities:

- (1) study of the reinvasion in Togo;
- (2) study of the reinvasion in Benin;
- (3) study to determine the width of territory on either side of the invaded rivers of Mali in which the transmission of onchocerciasis is of epidemiological importance;
- (4) surveillance of the Phase I and Ivory Coast extension area to confirm that the good results of 1979 were not due to exceptional climatic conditions.

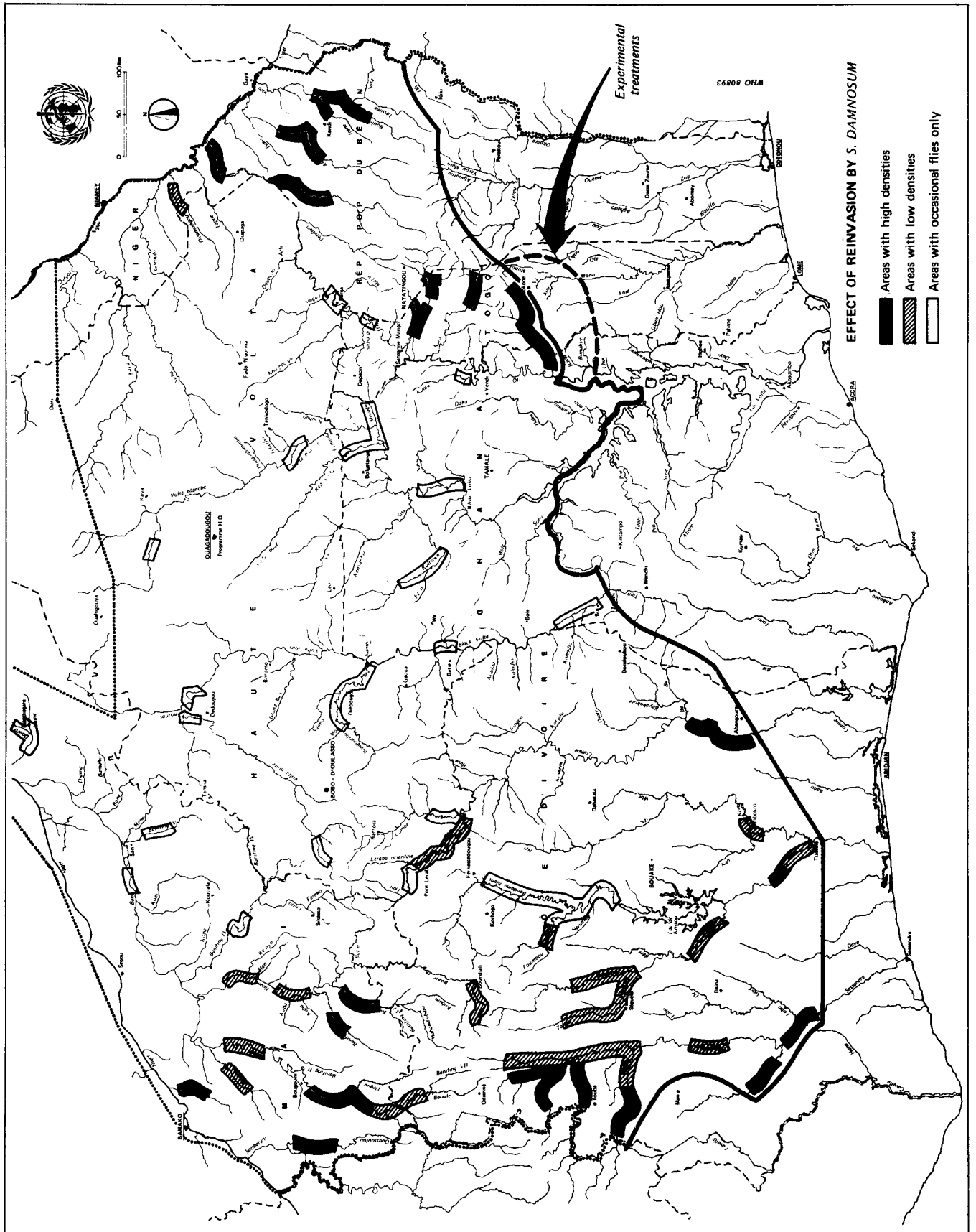
16. The team was based at Lama-Kara from May to July and concentrated its activities in the eastern zone. These activities included the analysis of meteorological data, and the collection and identification of adults and larvae from sites throughout the area. Different identification techniques were utilized e.g. morphological characteristics and enzyme analysis, to enable comparison of results. Eleven additional vector collecting teams were recruited to undertake daily catches at nine sites, four located in Togo and five in Benin and periodic catches at eight sites, four in Togo, two in Benin and two in Ghana.

17. In Togo experimental larvicide treatments were conducted on a trial basis for six weeks in the northern part of the extension area. Despite treatment failures due to the difficult terrain, fly numbers in the treated area remained below the levels of previous years and declined to about one-quarter in the reinvaded area (from 200-300 a day at MÔ bridge to 50/day). When treatment ceased there was a general increase in fly density. Data are still being analysed. However, the initial conclusion is that although results on the Kara have been encouraging, the area brought under control was not large enough to protect the MÔ valley sufficiently.

18. In Benin the investigation concentrated on identifying, through morphological and cytotaxonomical examination of material combined with aerial prospections, the possible sources of invading flies.

19. In the west of the Programme area, the situation improved considerably in 1979 with the extension of treatment in Ivory Coast. Sixteen sites located at special points were carefully monitored. In general the results confirm those of 1979 showing that the treatments of the Sassandra, Marahoué and Bandama basins have almost completely eliminated the invasion of the Phase I area. However, the small number of invading flies at Léraba bridge was four to five times higher in 1980 than in 1979 (see table page 5). It is considered that this is due to a higher level of invasion from the west than in previous years. In Phase III E there was no reduction in the S. damnosum densities along the Baoulé, Bagbe and Sankarani rivers of Mali. In fact at Madina Diassa during June and July densities were four to six times greater than in 1979 with a daily biting rate of 314 in July 1980 against 51 in July last year, again supporting the belief that there was a stronger western aspect to the reinvasion this year.

20. In the special study in Mali, catches were made along transects running at right angles to the river axis at Madina Diassa, on the river Baoulé, Yanfolila on river Sankarani, and at Point Faya on river Faya. At all three places biting rates and transmission potentials at 1 km from the river were about one-tenth of those at the riverside, and continued to decrease with distance. These figures will be used to estimate how wide is the band of dangerous transmission along these rivers.



Increased tolerance to Abate

21. The lower Bandama downstream from lake Kossou, Ivory Coast, came under regular insecticide treatment from March 1979. Results were very satisfactory and monthly catches dropped to one per man/day at Taabo and 0.7 at the Gauthier falls.
22. From the beginning of March 1980, numbers of biting females progressively increased reaching in mid-April 2000/man/day at Gauthier falls, nearly 400 at Taabo and around 150 at Tiassalé.
23. Weekly treatment was suspended at the beginning of May while a range of possible causes was investigated - faulty treatment, under-dosing, alteration in the insecticide formulation etc. At the end of May susceptibility tests showed the tolerance of S. sanctipauli¹ to Abate to be from 2.5 to 38.7 times greater than in 1977. It was decided to replace Abate by Chlorphoxim for six weeks' treatment of the Gauthier falls. Results were spectacular as catches fell from 2377 bites/man/day on 14 June to 99 on 7 July and one on 21 July.
24. The situation at Taabo, however, was progressively deteriorating, and pending the arrival of additional stocks of Chlorphoxim, it was decided to return to Abate treatment at the Gauthier falls and treat the Taabo reach with Chlorphoxim.
25. Fly levels at Gauthier falls subsequently stabilized at a low level, while at Taabo they are being controlled with difficulty due to the logistic problems of spraying.
26. This increased tolerance to Abate appeared after one year of regular treatment on the lower Bandama in Ivory Coast. It seems likely that it is connected with the relative isolation of the Simulium population and it is the first time that larviciding has been done in an area where the Sanctipauli/soubrense cytospecies are dominant.
27. The phenomenon seems to be confined to the Bandama basin. Biting populations are under strict surveillance and breeding sites are closely observed. These measures are combined with identification of species and intensive susceptibility monitoring. In September treatment was suspended on the stretches of river where resistance to Abate had been demonstrated pending the arrival of supplies of insecticide. When fresh supplies of Chlorphoxim are received, the whole of the lower Bandama, lower Nzi and lower Marahoué will be treated. The effect on the aquatic fauna will be monitored.

EPIDEMIOLOGICAL EVALUATION

28. Seventy villages were visited by the Programme evaluation team this year, of which 31 were situated in the extension study zones of Togo and Ghana.
29. The remaining 39 villages in Upper Volta, Ivory Coast, Mali, Togo, Ghana and Niger were being revisited for the second or third time. A summary of the epidemiological evaluation activities up to 31 August 1980 is given in the table on page 10 information on villages by country and phase is given on page 11.
30. In the Sikasso focus of Mali, under treatment since 1964, the proportion of infected persons did not exceed 10% in any of the villages visited, previously hyperendemic, and it may be said that onchocerciasis has become sporadic.
31. In the east of Upper Volta, in north Togo (Dapaon and Mango) and in Niger, under treatment since 1977, a definite improvement was observed. The disease has decreased on average by 20% as compared to the initial findings. The effects of control were certainly heightened by the drought which preceded the start of operations and during which natural transmission was reduced.

¹ S. sanctipauli is a species of the S. damnosum complex found in forest areas.

32. In Phase I of the Programme - the west of Upper Volta - the third visit to six villages showed spectacular results. The incidence of the disease was nil in all age-groups and all persons found negative in 1978 had remained so. Only a few cases remain in children under nine years of age. The situation in the age-range 10 to 14 years had greatly improved.

33. In the reinvasion area no significant change was found in the Togolese districts of Kandé and Lama-Kara where, despite treatment, an Annual Transmission Potential of 500-1000 larvae/man/year was recorded in the villages of Landa Pozanda and Titira. On the other hand, on the river Léraba at the Ivory Coast/Upper Volta frontier, where the reinvasion phenomenon has been controlled since the end of 1977, no infection was found in children under four years of age and the incidence of the disease had dropped to only 5% a year as compared to the 20% recorded previously.

34. As regards the ophthalmological aspects, a sharp reduction of parasites in the cornea was observed which was doubtless the reason for the absence of new cases of sclerosing keratitis in the sample examined. Very few irreversible ocular lesions had appeared and the incidence of blindness due to onchocerciasis has been practically nil since the interruption of transmission.

35. The chemotherapeutic trials carried out in 1979 at Bonga, Upper Volta, in collaboration with a team from the Ministry of Health, were evaluated after one year. Despite the low dose administered, Suramin was totally effective in patients who received 60 mg/kg or more. On the other hand, the worms were not completely destroyed in those who received a lower dose (50 mg or less), and one year later a few females were again reproductive.

36. In collaboration with the National Institute of Statistics and Demography of Upper Volta, data collected during evaluations on the birth and death rates of the blind are being analysed. Preliminary results show no effect of onchocerciasis on fertility, birth rates, and child mortality. In general, life expectancy of the blind is reduced. In fact the mortality of the blind appears to be two to three times greater, depending on the age-range, than for sighted persons of the same age for whom the death rate is consistent with the national average observed by the demographers.

37. Assistance was given to the Institute of Anthropobiology of the University of Utrecht, Netherlands, in the research it is conducting on the debilitating effects of onchocerciasis. The study will be carried out over a period of two years.

TABLE I. SUMMARY OF EPIDEMIOLOGICAL EVALUATIONS AS OF 31 AUGUST 1980

| | Composition of sample | | | Number of persons examined | | | | Number of individual examinations performed each year by Programme Teams | | | | | |
|-------------|--------------------------|-----------------|---------------------------|----------------------------|--------|----------------------|-------|--|--------|--------|--------|--------|--------|
| | Total number of villages | | Number of persons counted | By Programme teams | | By other teams | | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 |
| | ED ¹ | ES ¹ | | ED | ES | ED | ES | | | | | | |
| Benin | 59 | 13 | 46 | 2 166 | 10 187 | 541 | 1 305 | - | - | 2 667 | 4 704 | 4 982 | - |
| Ivory Coast | 87 | 25 | 62 | 4 334 | 13 005 | 1 203 | 1 394 | 4 179 | 3 485 | 2 378 | - | 8 357 | 689 |
| Ghana | 70 | 10 | 60 | 3 474 | 17 024 | - | - | 3 432 | 8 182 | - | 7 345 | 1 235 | 3 228 |
| Upper Volta | 117 | 18 | 99 | 3 615 | 25 135 | 667 | 371 | 11 101 | 9 061 | 6 241 | 8 453 | 4 512 | 3 404 |
| Mali | 59 | 7 | 52 | 1 065 | 11 851 | - | 52 | - | 5 444 | 7 991 | 442 | - | 781 |
| Niger | 17 | 4 | 13 | 797 | 2 172 | - | 535 | - | 582 | 1 470 | - | - | 916 |
| Togo | 41 | 11 | 30 | 2 707 | 9 446 | - | - | - | 3 972 | 5 196 | - | - | 4 909 |
| | | 88 | 362 | 18 158 | 88 820 | 2 411 | 3 657 | 18 712 | 30 726 | 25 943 | 20 944 | 19 086 | 13 927 |
| | 450 ² | 450 | 131 372 | 106 978 | 6 068 | 113 046 ³ | | 129 338 ³ | | | | | |

¹ ED = Detailed evaluation ES = Simple evaluation

² 419 of the 450 villages making up the sample were evaluated by the Programme Teams. The 31 other villages were evaluated by other teams. Eighty-three of the 450 villages lie outside the Programme area:

3 in Niger 27 in Ghana)
4 in Ivory Coast 24 in Togo) in the study zone
25 in Benin)

³ The difference between the number of persons examined and the number of individual annual examinations is explained by the fact that with the successive visits to the same villages, the same persons are examined several times.

CONSTITUTION OF THE SAMPLE

I. Number and distribution by phase and by country of the villages of the sample evaluated by the Programme teams

| | Upper Volta | Ivory Coast | Ghana | Mali | Togo | Benin | Niger | Total |
|-------------------|-------------|-------------|-------|------|------|-------|-------|-------|
| Phase 1 | 52 | 26 | 10 | 28 | - | - | - | 116 |
| Phase 2 | 35 | - | 29 | - | - | - | - | 64 |
| Phase 3 | 27 | 5 | 4 | 31 | 17 | 23 | 13 | 120 |
| Phase 4 | - | 36 | - | - | - | - | - | 36 |
| Outside programme | - | 4 | - | - | - | - | 3 | 7 |
| Study area | - | - | 27 | - | 24 | 25 | - | 76 |
| Total | 114 | 71 | 70 | 59 | 41 | 48 | 16 | 419* |

* To this total should be added 31 other villages evaluated by teams other than those of the Programme which brings to 450 the number of villages which made up the sample.

II. Number and distribution of villages by phase and by date of first examination

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | Total |
|-------------------|------|------|------|------|------|------|-------|
| Phase 1 | 45 | 51 | 17 | 1 | - | 2 | 116 |
| Phase 2 | 16 | 40 | 2 | 5 | 1 | - | 64 |
| Phase 3 | 12 | 27 | 51 | 27 | - | 3 | 120 |
| Phase 4 | - | - | 10 | - | 26 | - | 36 |
| Outside programme | - | - | 3 | - | 4 | - | 7 |
| Study area | - | - | 13 | 12 | 22 | 29 | 76 |
| Total | 73 | 118 | 96 | 45 | 53 | 34 | 419 |

EVALUATIONS

Number and distribution, by phase and by year

| | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | Total |
|-------------------|------|------|------|------|------|------|-------|
| Phase 1 | 47 | 55 | 24 | 20 | 6 | 17 | 169 |
| Phase 2 | 16 | 40 | 6 | 19 | 13 | 5 | 99 |
| Phase 3 | 12 | 27 | 51 | 29 | - | 19 | 138 |
| Phase 4 | - | - | 10 | - | 26 | - | 36 |
| Outside programme | - | - | 3 | - | 4 | - | 7 |
| Study area | - | - | 13 | 12 | 22 | 29 | 76 |
| Total | 75 | 122 | 107 | 80 | 71 | 70 | 525* |

* Out of 419 villages of the sample evaluated by the Programme teams:

- 333 villages were visited once
- 70 villages were evaluated twice
- 12 villages were evaluated three times
- 4 villages were evaluated four times

EXTENSION STUDIES

38. The collection of entomological data continued in the subsectors of Hohoe and Kintampo in Ghana, Atakpamé in Togo and Parakou in Benin. Dry and wet season aerial prospections confirmed that in Togo and Benin the southern limit of S. damnosum s.l. breeding sites lies further south than originally believed, passing through Benin at the junction of the river Ouémé and its tributary the Zou, 80 km from the sea, and including the Sio and Haho river systems 90 km from the coast in Togo.

39. All six cytospecies of the S. damnosum complex were found in the proposed extension area: S. damnosum, S. sirbanum, S. squamosum, S. soubrense, S. yahense and S. sanctipauli.

40. As regards Benin and Ghana, the national authorities are actively continuing their efforts to find a rapid and satisfactory solution to the logistic and financial problems entailed in the establishment of hydrological stations.

41. The epidemiological evaluation was concluded and confirmed the hyperendemicity of the disease in most of the main river basins. Between 1978 and 1980, 76 villages were examined of which 27 were situated in Ghana, 24 in Togo and 25 in Benin. The epidemiological map follows, in most cases, the geographical distribution of the vector.

42. In Ghana there is a hyperendemic zone along the Black Volta river and the lower Pru. In the whole central area of the Brong Ahafo Region, the disease is mesoendemic and affects the upper basin of the tributaries flowing into the Black Volta and Lake Volta, and the upper courses of the north-south rivers. This mesoendemic zone does not extend south of latitude 7°30N, below which onchocerciasis is hypoendemic.

43. In Togo the riverine villages of the Sio are hyperendemic to the south of Kpalimé as far as latitude 6°30'. The mountainous zone between Kpalimé and Badou appears to be free of the disease at the higher altitudes, the villages affected being situated at the foot of the massif. Ophthalmological findings indicate that the serious, savanna type of onchocerciasis is prevalent as far as the southern limit of the disease. No cases of the mild, forest-type onchocerciasis were found.

44. In Benin there is a vast mesoendemic zone to the north of a line running through Djougou, Bétérou, Parakou and Nikki, corresponding to the source of the watercourses flowing from north and south. The Okpara focus covers the middle course of the river along the Nigerian border, while on the Kouffo, onchocerciasis is concentrated in a small discrete focus on the middle reaches to the north of Lauta (7°05N).

45. The largest focus is that of the River Ouémé, where hyperendemicity extends from Bétérou (9°15N) to the confluence of the Ouémé with the Zou (7°N) and along the Téro, the Adjiro and the Terre rivers. This focus is the continuation of that affecting the lower part of the River Zou, the main tributary involved being the Agbado.

ECONOMIC DEVELOPMENT

46. In 1980 the task of the Economic Development Unit has been to support the training and research programme in health economics. So far four research and two training contracts have been concluded under this programme and the Unit itself is undertaking one research project.

47. In the field of research two contracts in the amount of US \$9 700 each were concluded with the University Association for Economic Research Clermont (AUREC), University of Clermont-Ferrand, France, and two others amounting to US \$33 572 and US \$ 44 405, respectively, with the Economic Development Research Centre, University of Michigan, United States of America. The four projects deal with the following topics:

- (a) a pilot study on the material facilities made available to migrants in AVV settlement villages, particularly agricultural credits;
- (b) a pilot study on analysis of the economic role and social status of persons affected by onchocerciasis;
- (c) two studies on health problems and policies in the OCP countries, one on the present situation and the other on comparison of the policies of sources of financing for health programmes;
- (d) preliminary phase of a study on the impact of onchocerciasis on labour productivity.

Field work for projects (a) and (b) was carried out in the first half of the year. Preliminary work on projects (c) and (d) began in September.

48. The research project being carried out by the Economic Development Unit concerns the spatial extent of resettlement in zones freed from onchocerciasis. It forms part of a larger project the next phase of which will be an assessment of the economic and social gains deriving from land resettlement (positive factors; improvement of living conditions as regards income, education, health, hygiene, etc.). The third and final phase will be a specific study of the economic and social repercussions of population movement in the OCP area.