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METHODS OF MASS EPIDEMIOLOGICAL EVALUATION OF ONCHOCERCIASIS.
 THEIR UTILIZATION IN A VECTOR CONTROL PROGRAMME

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1. INTRODUCTION

The purpose of making an epidemiological evaluation for a Simulium damnosum control campaign such as that being carried out in the Volta Basin is three-fold:

- (a) To ascertain the human impact of anti-vector campaigns by studying transmission. Is transmission continuing or has it stopped? Is there only residual transmission? What is the disease's incidence with vector control?
- (b) To follow the spontaneous course of the disease in the absence of transmission, when the aggravating factor of parasite accumulation ceases to operate.
- (c) To determine whether there is a transmission level which is tolerable for a population, i.e. a level of endemic and of parasite loads sufficiently low not to affect the general state of the individual.

Different techniques and survey methods may be used according to what is aimed at, and at different times.

First the basic survey has to be made, the point of departure for all subsequent comparisons. Techniques have to be devised in each case which are at once accurate, in order to obtain a scientific result, and simple and speedy so that they can be used on the spot in mass examinations.

The methods selected for making a medical evaluation in the case of the Volta Basin may be criticized. They do not use the most recent techniques. And they certainly are not such as to enable a full individual medical picture of a person who has onchocerciasis to be obtained. But the evaluation is only intended to enable two situations separated by a given interval of time to be compared, and the function of the methodology chosen is therefore to identify key factors which are clear-cut enough to indicate the changes that occur in the epidemiological situation during a period of time studied.

Much remains to be learnt from work of this kind. Every month brings new food for thought. It is not the purpose of this paper to attempt to prescribe a single methodology which is of universal application. The account of the standards used here, however, may perhaps be useful as a guide for future epidemiological surveys and constitute a minimum upon which consensus can be reached.

2. EVALUATION TECHNIQUES

2.1 Size of the sample

This is decided upon before the plan of operations is worked out, and is a matter for the statistician. In accordance with the population concerned and the degree of accuracy required he decides upon the minimum number of persons needed, the desirable number of clusters, and the clusters' size.

2.2 Selection of the clusters

In onchocerciasis the distribution and seriousness of the disease are closely dependent upon the man-vector relationship. They vary greatly from place to place, depending upon the contour of the water-courses and the relation of human settlements with the river, but they are homogeneous within one and the same local community. It is not essential therefore to use sampling techniques: to make a map of a village, number its inhabitants, number the individuals in each family, and then decide by lot which people to examine. This is a time-consuming method and very unpopular with the people who are not examined. People do not like forming part of a trial and are oblivious to the requirements of statistics.

In the Volta Basin it was therefore decided that the "village" should be the primary unit for the survey, the statistical cluster. Where a village is too large, one or more "neighbourhoods" are selected by lot and the whole of that neighbourhood or those neighbourhoods is examined. Similarly several small villages can be taken together to constitute one cluster.

The problem thus comes down to selecting villages. A number of criteria have been laid down for making this selection:

2.2.1 Level of endemicity

For surveillance of a vector control programme it seemed essential that 75% of the villages should be in hyperendemic areas or the upper bracket of mesoendemic areas (prevalence over 50%), in which regression could be more easily objectified, and 25% of the villages in areas of low or sporadic endemicity. This means examining, before the villages are selected, any documents and previous studies on onchocerciasis, its dispersion and prevalence.

2.2.2 Size of the villages

In order that the different age-groups should have minimum representation it would appear that 300 people is the desirable size of a cluster. It was decided that villages with a census population of over 1000 or 1500 should be excluded unless they consisted of easily individualized neighbourhoods. There is no lower limit however to the villages' size, because hyperendemic villages often have only 100 inhabitants or fewer.

2.2.3 Social homogeneity and stability

Since the surveys are longitudinal and the individuals have to be found again at intervals on each subsequent visit, it seems preferable to exclude places where demographic upheavals are going to occur: agricultural or agro-industrial projects entailing the disappearance of localities, influx of a seasonal or shifting labour force (sugar plantations), and nomadic areas.

Also excluded are administrative or commercial centres, where a proportion of the inhabitants have come from outside, only stay temporarily and are not representative of the local endemic, and where traders and craftsmen engage in a type of activity which exposes them less to the vector than is the case with peasants and so vitiate the overall findings.

On the other hand it seems advisable to include immigration areas in which a population that is often "virgin", and could constitute an excellent indicator of residual transmission, is (and will go on) settling in places freed from onchocerciasis.

2.2.4 Relationship with the entomological evaluation

It will be important to select certain villages in the immediate proximity of Simulium catching points, in order to be able to compare the parasitological observations with an amount of transmission identified by dissection of the flies.

It will be no less important to select villages away from such catching points, in order to check that the vector's disappearance and the endemic's decline in the proximity of the points under surveillance are in fact attended by a simultaneous and parallel development outside the identified and treated breeding places.

2.2.5 Geographical dispersal

The villages selected must be so distributed that all the streams that are carriers of breeding places, all the identified onchocerciasis foci, are represented in the sample. Inevitably vector control operations will have different results according to the contour of the river, and medical observations made in a focus cannot be extrapolated to an entire area.

This pinpoint aspect of evaluation means that the points selected must be geographically dispersed.

2.2.6 Accessibility

This criterion only applies to the ophthalmological examination, which involves the transport of heavy equipment. Onchocerciasis has sometimes been described as an "end of the road" disease, and to survey some points it may be necessary to go on foot.

2.2.7 Random selection

This comes into play after lists of the villages which comply with the foregoing criteria have been drawn up. It would be useless for example to rely upon a prior selection by administrative district, or even by level of endemicity (supposing this to be known for all the villages). The sample would not in those cases comply with the one or more of the criteria mentioned, which are considered essential.

When however a large number of villages meeting those requirements has been found, a random selection to decide which shall in fact be surveyed is in place.

2.3 Methodology of the surveys

2.3.1 All of the authors' surveys, irrespective of their nature, rest upon a three-fold basis:

- (a) an exhaustive census of the population constituting the sample decided upon,
- (b) a clinical and parasitological examination, with its variants,
- (c) an eye examination: either a full one, made by a qualified ophthalmologist, or a simple test (visual acuity).

2.3.2 There are three types of survey possible, dependent upon the object of the study being made.

(a) An ordinary prevalence survey, using form S 602 given in Annex 1. This is what is known as the "basic" evaluation. The purpose of it is to investigate transmission, its continuation or its cessation. It involves:

- an exhaustive census by families with identification of blood relationship including that of absent members
- parasitological examination by double biopsy
- rudimentary measurement of visual acuity by a simplified test identifying the blind and the pre-blind.

This type of survey both gives snapshots of the level of endemic at a particular moment, and makes possible longitudinal surveillance of people to ascertain their degree of infestation, the appearance of new cases of blindness and the fate of such cases.

(b) A parasitological survey. This can only deal with what is known as the "susceptible" group, i.e. the people who are certainly negative at the beginning of vector control operations. It covers only people born since the programme started, or "virgin" individuals from non-endemic areas settled in the surveillance area since the beginning of operations (immigration areas).

This type of survey determines solely the existence or non-existence of residual transmission. It takes less time than survey (a), and a larger number of points can be covered.

(c) A detailed survey, using form S 601 given in Annex 2. This comprises:

- an exhaustive census with personal identification and identification of migratory status
- a simple medical examination: weight, height, dermal lesions, lesions of the inguinal-scrotal area or of the lymphatic system, and number and site of nodules
- a parasitological examination
- other biological investigations where necessary
- exact measurement of visual acuity
- examination of both eyes with an ophthalmoscope and a slit lamp, before and after dilatation, covering all the existing ocular lesions, with measurement of intraocular pressure (tonometry).

The object of this last type of survey, confined to a limited number of people, is to add to knowledge of the disease and to trace its course at every level, both spontaneously in the absence of transmission, and under treatment.

2.3.3 Periodicity

The interval between two surveys is at present three years. The changes taking place in a single year do not appear to be large enough to warrant more frequent visits, nor do the survey techniques seem sensitive enough to detect them.

To check this point several clusters are going to be surveyed annually.

3. CARRYING OUT THE SURVEYS

3.1 Socio-demographic picture

3.1.1 The census

In each village chosen for the epidemiological evaluation the first thing to do is to make a census of the population (registration of residents present, residents absent, and visitors). This is a vital phase of the survey: the value of the longitudinal study made will depend upon how carefully it is carried out. This applies obviously to the first visit, but it also applies to the subsequent ones: in order to make possible easy location of the people present and the people absent at the present moment who have already been examined, together with new residents or visitors, the census of individuals is, on each occasion, carried out in family units.

3.1.2 Ordinary registration

The members of several family units are never entered on the same sheet of form S 602 (see Annex 1) used for the "basic" evaluation. If the family group is a large one, systematic registration of its members may require two or three sheets; on the other hand the name of a bachelor living in a separate dwelling on his own is given a whole sheet to itself.

Each person, assigned an individual number, is defined by the ethnic group and village he belongs to, his neighbourhood, his sex, his age,¹ whether he is present or absent at the time

¹ While exact age is usually not ascertainable in the case of adults, even when they have identity papers, it is considered essential to determine age exactly in the case of the children, who are indicators of recent transmission. For this, reliance is placed exclusively, before the age of 12 years, on age determination from the dental formula, in accordance with the table given in Annex 3.

of the visit, and his blood or marriage relationships ("Observations" - remarks - column). People making their appearance late, at the end of the visit, also any absentees identified directly (i.e. ones not declared by some head of family), are registered on a special sheet, if their identity cannot be entered immediately on one of the already existing family forms; it still remains possible to reclassify them on a later visit, since each person is always given an individual number that is transmitted to the computer after the first visit.

3.1.3 Detailed registration

Unlike the form just referred to, form S 601 (see Annex 2), the form for detailed evaluations, does not give the members of a family together on one page; it is strictly individual. It consists of three parts: socio-demographic, parasitological, and ophthalmological. The sociologist on the evaluation team checks the accuracy of the information in the first part.

Data additional to the initial information entered in form S 602 is given here:

- type of main occupation (farmer, fisherman, craftsman, trader, etc.);
- migratory status (length of time resident in the village);
- mobility between two consecutive survey visits (length of time spent away from the village, and where that time was spent).

For the detailed evaluation an individual form is necessary because of the amount of information collected. It occupies the whole of a 21 x 29.7 cm page; the back of the page may if necessary be used for quickly jotting down, in the field, ocular diagrams for the ophthalmologist. There are two things however against using this type of form only:

- (a) nothing would be recorded about the family structure to which the person belongs (his blood and/or marriage relationships) or, in the case of a migrant, about his place of origin or his present place of migration;
- (b) the splitting up of a cluster into a large number of individuals each registered on his own account greatly complicates the task of locating those people on a subsequent visit, and their identification is of course necessary for a longitudinal study.

These two difficulties have been avoided by using for census of the people involved in the detailed evaluation, also form OCP/EPI/75 (see Annex 4). Unlike forms S 601 and S 602 this does not have to be filled in completely at each visit; the first entries are added to on subsequent visits. The additional information provided by this form is not intended for data processing.

3.1.4 The village cards

In any case the information of an individual and family nature collected during the census provides, particularly in the instance of the detailed evaluations, a substantial store of qualitative information.

In so far as the level of onchocerciasis endemic in a particular place is neither fixed nor necessarily always homogeneous, transmission dynamics (increasing, stagnant or declining) depend in part upon a kind of life and socio-economic activity which is in its turn neither simple, nor fixed, nor necessarily always homogeneous. Factors like these, irrelevant to medical diagnosis, belong nevertheless to the field of epidemiology.

For each village examined, whether it is undergoing an ordinary or a detailed investigation, the sociologist on the evaluation team is responsible for establishing a "card" to which information will be added on the team's subsequent visits. Upon this card is entered routine information showing the date of each visit, its purpose, the onchocerciasis focus responsible, the comparative status of administrative censuses and of the census made by the evaluation unit, access conditions and working conditions, the name of the village chief, the history and structure of the settlement, the type of migration(s) if any, and technological innovations and local economic resources.

Where it is a matter of detailed evaluation the sociologist is expected as far as possible to keep the day-to-day life of the village community under observation, either himself or through others. An ideal arrangement would be that an investigator living on the spot should keep a record, between two three-yearly (or in rare cases four-yearly) visits by the evaluation team, of births, deaths, migratory movements and other outstanding events or happenings that occur in the village.

3.1.5 Relations with the villagers

Occupying a position midway as it were between laboratory research and mobile clinic work, an epidemiological evaluation aims, like laboratory research, at obtaining a scientific result while, like mobile clinic work, being required to establish a relationship of trust between the people studied (they are not patients) and the physicians (who do not necessarily perform any therapeutic function).

Without such trust, absenteeism will inevitably increase. At the very beginning of the surveys the Evaluation Unit of the programme enjoyed the benefit of the favourable preconception which African villagers entertain of medical teams that come to help them. But to keep them favourably disposed during the 20 years of surveys which are being envisaged for onchocerciasis, the members of the Evaluation Unit have got to be able to win lasting acceptance for themselves. To achieve this the objects of the operation being undertaken and the means being employed should be clearly explained to the villagers. It is typical that in one particular village on the Volta Noire the authors were the first to point out to the inhabitants the connexion between what the helicopters were doing, what the catchers were doing, and the work of the medical team which was visiting them. Up till then the village chief and notables did not know why every week, for months and months, catchers had been coming to their village in a Landrover and installing themselves on the river bank, apparently without doing anything, for an entire day. Nobody before had thought of offering that sort of explanation, or been willing to spend the time and to take the steps required for giving it.

The maintenance of relations of trust and mutual information with the authorities responsible for the villages' administration on the one hand (prefects, subprefects, heads of medical sectors or circumscriptions), and with the villagers living in the areas visited on the other, is an indispensable feature of a sound evaluation method. Here "savoir faire" is essential, and it must be displayed in the survey area the whole time by all the members of the Unit (from physicians to drivers).

3.2 The clinical examination

In addition to ascertaining anthropometric data (weight and height) this examination involves looking for direct or indirect onchocerciasis lesions, i.e.:

- site and number of nodules (onchocercomas);
- dermatological involvement (its degree and extent): ordinary scratching lesions, papular onchodermatitis, pachyderma, lichenification, atrophy of the skin, local melanoleucoderma;
- involvement of the lymphatic system: elephantiasis, hypertrophy of the inguinal glands and hanging groin;
- genital lesions: hydrocele with or without hernia.

3.3 The parasitological examination

Until more accurate methods have been devised (serology) this depends upon looking for O. volvulus microfilariae in an exsanguinated skin biopsy.

In order that the findings may be comparable in all villages the examination has been codified in accordance with the following rules, derived from Picq's method:

- (a) Calibrated biopsies are taken with a 2.5 mm standardized punch (Walser-type sclerectomy punch). Weighing and other measurements of the surface or volume of the biopsy (Duke, Brinkmann) are of interest for research purposes, but are not practicable in mass evaluations.
- (b) Biopsies are localized in the iliac crest, that site being recognized as the most productive one in the programme area (research performed by the Parasitological Section, Centre Muraz).
- (c) Two biopsies are taken from this site, one at the right of it, the other at the left. A double snip enables 6% more positive people to be detected in the general population, or even 12% more (test performed on 1100 snips, WHO 1975).
- (d) The skin fragments are placed on the same slide in two drops of distilled water. Reading is easier than in physiological serum in the field: there is no salt deposit to hamper reading, the filariae are less mobile, and it is possible to add to the liquid periodically without danger of concentrating the solution.
- (e) Readings are made with a binocular lens after 30 minutes (x 25 magnification): this is the time taken for 50% of the microfilariae to emerge from the fragment (see Picq); a lens enables a broader field to be examined than a microscope, and makes possible more accurate counts.
- (f) The negative slides are kept and read 30 minutes later, 60 minutes after the biopsy was taken.
- (g) When the slides are read as accurate a count as possible is made of the number of microfilariae observed in either fragment.
- (h) A certain percentage of the slides are kept for possible identification after Dipetalonema streptocerca staining.
- (i) Ten per cent. of the slides are double read by what is known as the blind method. Each microscopist is in this way routinely tested against the physician specialist and against his colleagues. Findings are considered reliable when less than 10% of quantitative findings do not belong to the same broad numerical category as the first reading findings (see 4.3 below).

3.4 The serological examination

Methods are still experimental, and cross reactions with W. bancrofti remain constant. These methods require improvement, and the day may come when biopsies and direct microfilaria detection are considered to be unduly gross methods either for assessing a slight infestation and for evaluating the presence of residual transmission.

3.5 Xenodiagnosis

O. volvulus microfilariae are looked for in the stomach contents of Simulium engorged on a suspected person. Some authors believe this examination to be more reliable and accurate than a snip.

The difficulty of carrying it out will prevent it from ever becoming a mass evaluation method.

3.6 Mazzotti test

This test is not recommended without recourse to evaluation surveys. Apart from its inaccuracy (positivity in the presence of W. bancrofti, etc.), it is not greatly liked and provides no correct information of a quantitative nature.

3.7 The ophthalmological examination

3.7.1. Some important ophthalmological principles for the epidemiological evaluation of onchocerciasis in an area, are:

- (a) continuous clinical and epidemiological evaluation of the total amount of blindness and impaired vision in the population.
- (b) estimation of the importance of onchocerciasis as a blinding disease, related to different endemicity levels and populations.
- (c) estimation of the influence of other diseases on the rates of visual impairment, and their future role in relation to a changed onchocerciasis transmission.
- (d) continuous clinical study of the different ocular onchocerciasis lesions and their development in relation to various degrees of transmission, or medical treatment. This will imply a definition of variables for estimation of the intensity and gravity of ocular onchocerciasis.

The definition of visual impairment used here, is that of the Study Group¹ on the Prevention of Blindness, WHO 1972, categories 1-5. This means that "blindness" corresponds to category 3-5, "severe visual impairment" is category 2 and "visual impairment" category 1.

It is most important to screen population groups with visual impairment, and many field surveys have been carried out on onchocerciasis for this purpose. It must be emphasized however, that there are many inaccuracies connected with visual acuity testing in an illiterate population. From the epidemiological point of view, it is important to find not only the blind people, but also those at risk of becoming blind. There must be a continuous follow-up of the groups at risk and their development of further visual impairment in relation to changing transmission, and finally the sociological and economical pattern they will fit into. This is fundamental for estimations of the benefit of an anti-Simulium-campaign and later medical mass-treatment actions.

3.7.2 Visual acuity tests

The most common methodology used in the field is the illiterate "E-test", or sometimes the circles of Landolt. Although some authors claim fairly good results with the "E-test" there are some obvious disadvantages. For most of the people involved the "E" represents an unknown geometrical figure, and the effort to recognize the figure occupies all of their attention. Also, there is a lack of a good, standardized chart with several test types for the visual acuity level of 0.1 to 0.3. It would be preferable to have separate sheets or a cube with isolated Es on each side in various sizes, and a fixed test distance related to the actual definitions and levels of visual impairment.

The testing of visual acuity in a group of people in a village is a very complex psychological situation. There are the neighbours who have already passed the test and now are laughing, children that are afraid, shy women and traditional attitudes against this new and disturbing element brought into the village. All these factors may produce an apparent reduction in vision. It is obligatory to take your time with each case, test and re-test, to finally find out a probable visual acuity level. There is already evidence from the field work that women and children very often cannot understand the "E-test". In our experience about 50% of the children aged less than 10 years can understand and cooperate in this test.

In order to improve cooperation in the visual acuity test, we are trying the "Sjögren Hand-test" during 1975. This test utilizes a figure of a black hand on a white background, in various sizes on separate sheets, at a fixed test distance of five metres. The testing procedure is the same as with the "E-test", but as the results are given in a scale 5/50 to 5/5 it is possible to define the important levels for visual impairment. The Sjögren test has given very good results with children from the age of three to four years in Europe, and will perhaps give us more reliable results.

At present we conduct in the field the visual acuity test at two different levels. For the "detailed" evaluation (see previous chapter concerning sampling and methodology) with a complete ophthalmological examination, the "E-test" is used, and the results coded:

0	=	1.0
1	=	0.7
2	=	0.3
3	=	0.1
4	=	finger counting at three metres
5	=	finger counting at one metre
6	=	perception of light
7	=	amaurosis
8	=	not able to cooperate
9	=	not examined.

Each eye is tested separately, without correction. The code gives the level of normal, impaired and severely impaired vision, as well as three stages of blindness.

For the basic, global evaluation, a much simpler methodology is used, which is still reliable and less time-consuming. As the most important thing is to find the pre-blind risk group, a preliminary screening procedure with the "E" or "Sjögren" test at the visual acuity level of 0.3 both eyes should be used. Further examination is then performed only on the group that does not pass this test level. The results are coded in four categories: blindness, severe visual impairment, visual impairment and no visual impairment.

The interpretation of the results from the visual acuity testing presents some problems. With a detailed ophthalmological examination as background it is possible to state the probable main cause of visual impairment in the majority of cases with reduced vision code 3 or more, of the form S 601 (see Annex 2). There remain a number of unexplained visual impairment cases, which are those cooperating poorly or with refractive anomalies or early undetectable posterior lesions. However, when a sufficient number of examinations have been conducted, it should be possible to estimate the size of this bias.

Although it is time-consuming and sometimes difficult, a complete ophthalmological examination is necessary. An epidemiological study on onchocerciasis must include a precise diagnosis of the individual going blind. The clinical appearance of the disease is influenced by, for instance, age, sex, exposure to transmission and other ocular disorders. This must be kept in mind to give a relevant estimation of onchocerciasis and its importance for blindness.

In the OCP field surveys a standardized form (see Annex 2) is used with coding for each listed sign.

3.7.3 Examination methodology

The patient, following a visual acuity test, is examined in a dark room. After having had his head down for at least one minute, he is examined with the slit lamp (Haag-Streit) magnification x 16, and the number of living microfilariae (mf.) in the anterior chamber is counted, or estimated if high in both eyes. The dead and living mf. in the cornea are counted with magnification x 25. Other abnormalities in the cornea are noted, with a separate code for signs of corneal complications of trachoma. Pupillary reactions and the appearance of iris and eventual iritis are checked. A bilateral tonometry is then performed on patients of more than 10 years old. The eyes of all patients are dilated if there is no

obvious contraindication, using a drop of tropicamide 1% in each eye. After minimum half an hour the patient is reintroduced to the dark room, and the slit lamp examination completed by looking for mf. on the lens and in the vitreous. Finally the fundus is examined by ophthalmoscopy, direct and indirect technique. In some selected cases the visual fields are tested by the confrontation methodology of Donders' to get an approximate idea of severe restrictions. A Kowa RC2 camera is used for documentation of developing serious lesions. In case of a raised intra-ocular pressure, gonioscopy is performed if possible. The reverse of form S 601 can be used for drawings of any lesions or extra notes.

The reliability of the diagnosis of ocular onchocerciasis may be relative in some cases, where there is a mixed ocular pathology from other disorders. The final diagnosis must be a conclusion of all the signs and their relevance to onchocerciasis and an eventual visual impairment.

In general, onchocerciasis gives rise to a blindness in the adult population, i.e. from the third decade of life. However, in children also, serious and irreversible eye lesions are seen, especially in those with head nodules. It is most important to find out the age and sex specific prevalence of impaired vision in relation to different endemicity levels of onchocerciasis. Even if the general correlation between the prevalences of onchocerciasis and visual impairment is well-known, we may still find differences hard to explain. It may be a question of geographical factors, heterogeneous exposure to transmission within a population or influence of different cytotypes of the vector. Classically, onchocerciasis causes more blindness in men than in women, but there are exceptions to this rule. To make an estimate of the probable total amount of visual impairment caused by onchocerciasis a sufficient number of detailed eye examinations must be performed in different regions and populations. This will provide good baseline data today, and with a continuous follow-up of the groups at risk in the future, we will be able to estimate the cost-benefit relationship of an action taken against the disease.

3.7.4 The design of the examination form S 601 (see Annex 2) is such that it should give not only a detailed diagnosis of onchocerciasis, but also of other ophthalmological diseases. Today, onchocerciasis is certainly the dominating blinding condition in the Volta River Basin Area, but this situation will probably change in the future. This will be due to not only the eradication of the vector or medical treatment of the disease, but also due to aspects of economical development in an area with its concomitant change in social structure. With reinforced public health planning for instance, there will probably be a change of birth and death rates, life expectancy for the individual and the general spectre of diseases in the population. This may highly influence the epidemiology of ocular disorders.

The problem concerning the diagnosis of several diseases in a patient is sometimes very complex. Onchocerciasis may well give a secondary glaucoma, but this may also be idiopathic or caused by several other diseases. Iritis is more common in onchocerciasis cases, but not at all a specific sign. The presence of an iritis in a case of ocular onchocerciasis does not necessarily mean a causal connexion. Still, in the majority of cases, it is possible to state the main disease and its influence on the visual acuity.

The knowledge of the spectre of eye diseases in different age-groups is important. Blindness during childhood often means the possibility of congenital disorders, nutritional deficiencies, measles, trauma or trachoma, while onchocerciasis plays its role at a later stage of life. In the older age-groups one may find genuine glaucomas and senile cataracts or retinal degenerations. To evaluate the future and final result of any action against onchocerciasis, and its relation to the prevention of blindness, we have to know also about the influence of other eye diseases in different age-groups and populations.

3.7.5 There has been much discussion about the ocular lesions of onchocerciasis, their relevance and specificity, and there is still disagreement concerning the nature of the posterior lesions. Our knowledge is still limited concerning the development of existing ocular onchocerciasis lesions after the transmission is terminated. The eradication of the vector will mean a new situation. As an integral part of the epidemiological evaluation, it will be necessary to conduct a continuous clinical study on the ocular lesions of

onchocerciasis and their influence on the visual acuity in the future. In event of transmission still remaining, it will be most important to find out the "acceptable" transmission level in relation to future visual impairment. There is a need for uniform criteria for the estimation of the intensity of ocular onchocerciasis in the individual. A uniform, clinical score, based on the important eye lesions such as corneal density of mf., sclerosing keratitis or retinal lesions, would be suitable. A system like this would also facilitate the clinical follow-up of a given medical treatment. Certainly, a clinical score used for evaluation of the intensity of the ocular lesions will have to be continuously revised with increasing experience of the ocular risk factors in onchocerciasis.

To elucidate the nature of ocular onchocerciasis and its importance to visual impairment in a population, an index on the relative gravity of the disease would give a more distinct picture. The endemicity level may well be the same in two adjacent regions, but the number of people going blind from onchocerciasis quite different, for several reasons. There is already in use the term "severe ocular onchocerciasis", but the problem is to define this, and its relation to future blindness.

In the OCP, the same term is used to express the percentage of the population with ocular onchocerciasis, and those with severe and irreversible ocular lesions of onchocerciasis. The preliminary evaluation of these lesions is based on the presence of any degree of sclerosing keratitis, post-neuritic and consecutive optic atrophy and typical retinal lesions with typical distribution. In other field surveys iritis has also been included. However, to avoid confusion a uniform and well defined criterion representing the gravity of ocular onchocerciasis should be adopted, and should also be adjusted for age and sex. Such a system would facilitate detailed analysis and direct comparisons of future clinical and epidemiological evaluations.

4. WORKING UP THE DATA

Storing all the results in a computer is indispensable for a longitudinal study because manual processing of the information would be too complicated.

But a number of calculations and analyses can be made at once for study of level of endemic, intensity of infestation, and comparison of villages and foci with one another. Some of these - the list is not exhaustive - are mentioned below.

4.1 Calculation of prevalence by sex and age-group

This is a simple percentage which objectivises the speed of individuals' positivisation and difference according to sex. Owing to people's uncertainty about their age the age-groups will be rather broad: five-year groups up to the age of 15 (exact dental ages), then 15-29, 30-49, and 50 and over (see form for working up data, Annex 5).

4.2 Calculation of the global prevalence of onchocerciasis by village

The foregoing data need adjusting here for age and sex by reference to a standard population the distribution of which acts as a weighting factor. This standard population could be the national census population. Or it could be an arbitrary one, from outside the area. For OCP programme purposes the first 6500 examinations made have been taken as the standard population.

4.3 Measurement of intensity by age-group, by sex, and by broad numerical categories of quantitative biopsies

Since human reading error increases with the number of microfilariae to be counted, the numerical categories have to be ones of increasing size.

The categories selected by the authors are 1 to 9, 10 to 49, 50 to 99, 100 to 199, and over 200 microfilariae (total of two biopsies). Rougemont suggests categories increasing in a logarithmic progression: 1 to 10, 11 to 30, 31 to 70 microfilariae, etc.

4.4 Calculation of mean microfilaria loads in a given group: sex, sex and age-group, entire village, etc.

Here again comparison of two samples involves recourse to weighting by reference to a standard population. This average could be an arithmetical mean. In that case a discrepancy of a very large or very small load results in unduly large range variations. For this reason the authors use the geometrical mean, which is more accurate since it minimizes the effect of discrepancies.

It is possible to calculate this from the total number of persons in the age-group examined, including those who are negative. In the authors' view however, and it is also Rougemont's, this way of expressing the mean mixes together two different ideas: prevalence, and intensity of infestation. What is used here therefore for measuring intensity of infestation is the geometrical mean of microfilaria loads of positive persons, by sex and age-group - a weighted average in the case of the overall findings for a village.

4.5 Determination in each village of the age at which 50% of people are positive

This method, suggested by Knüttgen, is really useful in hypo- or mesoendemic areas, but is not a sufficiently sensitive indicator for hyperendemic areas.

4.6 Plotting the positivisation curve in relation to age on millimetre graph paper

The character of this curve varies with the endemic level and shows the speed of positivisation. Calculating the slope of the curve by a mathematical formula is a useful way of comparing a number of samples.

4.7 Statistical evaluation of ocular lesions

- (a) Ocular onchocercal involvement rates in the population.
- (b) Percentage of involvements which are serious or irreversible.
- (c) Pre-blindness rates in the general population, dividing into two categories visual acuities between 0.3 and blindness as defined in the WHO report already referred to.
- (d) Blindness rates, calculated on a basis of the census population and not just of the people examined, allowing for absent people who may be blind.

All these rates have to be weighted for age and sex to make them comparable from village to village.

5. CONCLUSIONS

It is not possible, six months after the commencement of a programme for control of S. damnosum, the vector of onchocerciasis, to make a normative statement as to what evaluation techniques ought to be.

Subsequent use of computers will enable all desirable connexions to be investigated: the relation between ophthalmological lesions and intensity of parasite infestation; longitudinal surveillance of individuals; the link between level of endemic, intensity of infestation and entomological findings (number of catches, number of infective females, number of infective bites per man and per day); and study of a mathematical model of transmission.

As the programme goes on, more will have to be done and improvements will have to be made. Lessons are learnt from each evaluation, modifying to a greater or lesser extent the initial line. The main thing is to take the present methodology as the common basis for all surveys, which is essential if they are to be comparable.

ANNEX 2

PROGRAMME DE LUTTE CONTRE L'ONCHOCERCOSE - BASSIN DE LA VOLTA - EXAMEN DETAILLE - FORMULAIRE :			8601	1-4
Date de l'enquête :	<input type="text"/> <input type="text"/> 19 <input type="text"/> <input type="text"/> <small>mois année</small>	Passage N°	<input type="text"/> <input type="text"/>	5-10
Etat :	Village :	Quartier :	Famille N°	11-19
Numéro individuel :	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>		Sexe :	20-28
Nom de la personne :			Ethnie :	29-31
Déjà enregistré ? - oui, non :	<input type="checkbox"/> <input type="checkbox"/>	Durée de résidence :	Mobilité :	32-35
Statut examen :	<input type="checkbox"/>	Activité principale :	Fréquentation scolaire :	36-38
Traitement avant premier enregistrement :	<input type="checkbox"/>	Traitement depuis passage précédent :	<input type="checkbox"/>	39-40

<p>Taille (cm) : <input type="text"/> <input type="text"/> <input type="text"/> 41-43</p> <p>Poids (kg) : <input type="text"/> <input type="text"/> 44-45</p> <p>Grossesse visible : <input type="checkbox"/> 46</p> <p>Lésions cutanées onchocerquiennes : <input type="checkbox"/> 47</p> <p>Vitiligo : <input type="checkbox"/> 48</p> <p>Kystes - sur la tête et le cou : <input type="checkbox"/> 49</p> <p style="padding-left: 20px;">- sur corps et extrémités : <input type="text"/> <input type="text"/> 50-51</p> <p>Eléphantiasis des extrémités : <input type="checkbox"/> 52</p> <p>Pli inguinal : <input type="checkbox"/> 53</p> <p>Scrotum : <input type="checkbox"/> 54</p> <p>Biopsies cutanées</p> <p style="padding-left: 20px;">- crêtes iliaques : <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 1 2 55-60</p> <p style="padding-left: 20px;">- autre site : <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 61-64</p>	<table style="width:100%; border-collapse: collapse;"> <tr> <td style="width:80%;">Visual acuity :</td> <td style="width:5%; text-align: center;">R</td> <td style="width:5%; text-align: center;">L</td> <td style="width:10%; text-align: right;">85-86</td> </tr> <tr> <td>M F A C :</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">87-88</td> </tr> <tr> <td>Cornea :</td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">a) Microfilariae (x 16)</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">89-90</td> </tr> <tr> <td style="padding-left: 20px;">b) Onchocorneal opacities ...</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">91-92</td> </tr> <tr> <td style="padding-left: 20px;">c) Other opacities</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">93-94</td> </tr> <tr> <td style="padding-left: 20px;">d) Living mfs. (x 25)</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">95-96</td> </tr> <tr> <td style="padding-left: 20px;">e) Sclerosing keratitis</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">97-98</td> </tr> <tr> <td style="padding-left: 20px;">f) Trachoma</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">99-100</td> </tr> <tr> <td>Pupil :</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">101-102</td> </tr> <tr> <td>Iritis :</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">103-104</td> </tr> <tr> <td>Cataract :</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">105-106</td> </tr> <tr> <td>Vitreous :</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">107-108</td> </tr> <tr> <td>Optic disc :</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">109-110</td> </tr> <tr> <td>Retinal vessels :</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">111-112</td> </tr> <tr> <td>Choroïdo-retinitis (oncho) :</td> <td></td> <td></td> <td></td> </tr> <tr> <td style="padding-left: 20px;">a) Morphology</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">113-114</td> </tr> <tr> <td style="padding-left: 20px;">b) Margin</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">115-116</td> </tr> <tr> <td style="padding-left: 20px;">c) Site</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">117-118</td> </tr> <tr> <td>Focal choroiditis :</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">119-120</td> </tr> <tr> <td>Visual field :</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">121-122</td> </tr> <tr> <td>Main cause of visual impairment :</td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: right;">123-124</td> </tr> <tr> <td>I O P :</td> <td style="text-align: center;"><input type="text"/> <input type="text"/></td> <td style="text-align: center;"><input type="text"/> <input type="text"/></td> <td style="text-align: right;">125-128</td> </tr> </table>	Visual acuity :	R	L	85-86	M F A C :	<input type="checkbox"/>	<input type="checkbox"/>	87-88	Cornea :				a) Microfilariae (x 16)	<input type="checkbox"/>	<input type="checkbox"/>	89-90	b) Onchocorneal opacities ...	<input type="checkbox"/>	<input type="checkbox"/>	91-92	c) Other opacities	<input type="checkbox"/>	<input type="checkbox"/>	93-94	d) Living mfs. 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Spécimen	Méthode	Résultat
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/> <input type="text"/> 75-79
<input type="checkbox"/>	<input type="checkbox"/>	<input type="text"/> <input type="text"/> <input type="text"/> 80-84

Observations :	<input type="checkbox"/> <input type="checkbox"/> 129-130
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TABLE FOR DETERMINING CHILDREN'S AGE
FROM THE DENTAL FORMULA

(from TREBAUL)

Milk teeth		Permanent teeth	
<u>I I</u>	6 to 8 months	<u>I.II.III.IV.V.6</u> <u>I.II.III.IV.V.6</u>	6 years (6-year tooth)
<u>I I</u> <u>I I</u>	8 to 10 months	<u>I.II.III.IV.V.6</u> <u>I.II.III.IV.V.6</u>	7 years
<u>II.I I.II</u> <u>I I</u>	12 months	<u>1.2.III.IV.V.6</u>	8 years
<u>II.I I.II</u> <u>II.I I.II</u>	14 months	<u>1.2.III.4.V.6</u>	9 years
<u>I.II.IV</u>	16 months (1st milk molar)	<u>1.2.3.4.V.6</u>	10 years
<u>I.II.III.IV</u>	18 months (milk canine)	<u>1.2.3.4.5.6</u>	11 years
<u>I.II.III.IV.V</u>	20 to 30 months (2nd milk molar)	<u>1.2.3.4.5.6.7</u>	12 years (12-year tooth)

The Roman figures indicate milk teeth and the Arabic figures permanent teeth.

Unless otherwise shown in this table, the four half-jaws are symmetrical.
Variations in the ages of appearance given range from two months for milk teeth to one year for permanent teeth.

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