

# PATANA BURNING WITH PARTICULAR REFERENCE TO PASTURAGE AND WET PATANAS

## A PRELIMINARY NOTE

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WITH FOUR PLATES

### INTRODUCTION.

**P**ATANAS are large tracts of undulating grasslands, similar to savannahs, in the centre, east, and south-east of Ceylon. A good account of the botany of the Ceylon patanas is given by H. H. W. Pearson (1), and by J. Parkin and H. H. W. Pearson (2). They are of economic interest as pasturage areas.

In Ceylon the burning of patanas has been practised from ancient times. More recently there has been an outcry against the custom and from time to time attempts have been made to put an end to the practice. Now it is questioned whether burning is really harmful.

Patanas were burnt mainly by the grazier in order to provide fresh succulent pasturage for his cattle and buffaloes; to a small extent by the hunter to drive out game; and sometimes accidentally.

### THE PROBLEM.

The relatively high rainfall of the patanas is not evenly distributed throughout the year, but is seasonal. There are periods of about four months each—the monsoons—during which most of the precipitation takes place, alternating with periods of relative drought. With the commencement of a rainy season the patana grasses start a very active period of vegetative growth which ends with the cessation of the monsoon rains, after which, growth slows down again, and becomes relatively quiescent.

In unburnt areas the large tufts of the patana grasses produce fresh growth, which, however, being surrounded by the old, coarse, fibrous, unpalatable leaves and old stalks, is not easily accessible to stock. At most, they can bite off only the protruding tops at the crown of the tuft. Thus old, dry grass accumulates at the base of the plants, and forms a layer of varying thickness on the ground. This fibrous material does

not readily decay and, as the years go on, the layer becomes thicker and thicker while the plants go on producing less and less feed for stock.

The burning of such a patana has the effect of removing the undecayed layer and the coarse, dry grass, while providing also a certain amount of readily utilizable manure in the form of ash, and of stimulating the plants to fresh, vigorous growth.

After burning, the grass shoots up and the fresh, succulent, palatable grass is very tempting to stock and readily grazed by them. Vegetative growth is so prolific that much more than can be consumed by the limited herds is produced, and consequently, only the tenderest portions are eaten and the rest left. Wild herbivorous animals such as elk from the nearby forests roam at night over this luxuriant pasture and, although consuming some of the rich herbage, enrich the soil with their droppings. Still, so vast are the patanas and so prolific the growth of grass in relation to the feeding animals that there is no question of overgrazing, and more than sufficient leaf is left to the plants for storage of food in the underground rhizomes for future use. This is particularly true of the wet patanas where, from a pasture point of view, there appears to be no deterioration in quality and quantity of feed in spite of all the burning that has been taking place in the past. Rather the contrary.

It is now a well-known fact that quite irrespective of species, tender grass is very rich in protein. Conditions being such, can the grazier be blamed for this age-old practice which, with very little effort on his part, provides him with such a wealth of pasturage for his stock? Why then has the practice been condemned?

The chief objection to burning has been on the ground of soil erosion. What is the effect of burning on the land *qua* land? Denuding any land of its cover of vegetation, particularly its low, ground cover, causes erosion, especially in sloping land as in the case of patanas. To what extent does burning actually increase soil erosion and how does burnt patana land compare in fertility with similar but unburnt areas over a long period of years? And during the same period how far does the harm, if at all, counterbalance the advantage of plentiful, rich pasturage? To answer these questions we must consider the effect on the vegetative cover.

#### SUCCESSION.

It is common observation that vegetation in a state of relative equilibrium with its environment when interfered with, as by burning, reacts in a definite direction. Thus, when an area forming part of a forest is burnt and left to itself, the bare ground is soon covered with grasses and herbs; later, shrubs

appear and ultimately trees when that relative equilibrium is again reached. This change from bare ground, in stages, to vegetation in relative equilibrium with its environment, in this case forest, is known as succession.

This change may take many years or many hundreds of years. In fact, vegetation is constantly changing and the rate of change varies greatly. Once relative equilibrium is reached changes still go on but they are so slow as to be hardly noticeable in short periods of a few years.

Coming back to the area of burnt forest which has again become forest, the same type of forest as that surrounding it is possible only if the other factors of environment have continued to remain relatively unaltered. But if, for example, the soil has quickly changed owing to soil erosion or other causes so that the fertility has been greatly diminished, the forest stage may not be reached but a relatively stable scrub type of vegetation may be formed. Such is seen in the scrub formed after chena cultivation in the dry zone. Again, if forest or scrub are not given time to form, as by frequent burning, a grassland type may become relatively stable. Thus probably originated the large stretches of patanas which exist today in an otherwise forest-clad environment.

In each case the stage of relative equilibrium reached is known as the climax stage: thus in the examples cited above, the climax stage is forest in the first case, scrub in the second, and grassland in the third.

There may be still smaller sub-divisions as climax stages *e.g.*, in grassland, relative equilibrium with the environment may be reached with the large, tufted grass, *mana* (Sinhalese), *Cymbopogon confertiflorus* (Steud.) Stapf, dominant; or with the smaller, tufted grass *pini-baru-tana* (Sinhalese), *Themeda tremula* (Nees ex Steud.) Hack., dominant; or with the wiry, tufted grass *et-tuttiri* (Sinhalese), *Aristida setacea* Retz., (or *A. Adscensionis* L.) dominant: in which cases the climax will be the *mana* dominant stage, or the *pini-baru-tana* dominant stage, or the *et-tuttiri* dominant stage respectively.

#### THE CEYLON PATANAS.

Patanas form a distinct and homogeneous type of natural grassland with well-defined characters. Their area is not known. Quoting Pearson (1): "Tennent almost certainly exaggerates when he says 'the extent of this patana-land is enormous in Ceylon, amounting to millions of acres'. The area of the district under consideration may be taken roughly as 200,000 acres [73,000 hectares]. The flora of the patanas as a whole is composed of plants which, generally speaking, present characters which tend to reduce transpiration and to

protect delicate parts from the injurious effects of intense illumination : broadly speaking, it may thus be regarded as a ' Xerophyte-Association ' in Warming's sense ". Patanas are large savannah-like regions, mostly composed of coarse tussocky grasses, of which only the tender shoots of some are palatable. Patanas appear to be a climax type ; several theories have been advanced to account for this. Characteristic patana country is found in Uva at altitudes from 2,000 to 4,500 feet. From the Uva patanas of these lower altitudes, " wide and extensive tongues of patana-vegetation protrude into the forest on the eastern slopes of the central ridge, and even in places cross the summit of the ridge : thus, extensive patanas are found on Horton Plains (7,000 ft.), on the eastern slopes of Totapella, up the Hakgala valley, and across the ridge as far as Nuwara Eliya ". Pearson's work should be consulted for a full account of the patana vegetation. (Senaratna (3).)

The patana areas may be conveniently considered under two main sub-divisions—the dry patanas, and the wet patanas.

#### THE DRY PATANAS.

The dry patanas occur between 2,000 and 4,500 feet elevation. They receive 75 to 100 inches of rainfall but most of it during the North-East Monsoon, so that during the remaining eight months of the year, March to October, they experience relative drought. They are more savannah-like than are the wet patanas. Quoting Pearson, again, " . . . the conditions which determine the characteristic features of the flora are, briefly, intense illumination, the heating effects of the rays of a vertical sun, and a comparatively dry season of eight months' duration, during six months of which a drying wind blows constantly over the area and the sky is usually unclouded. The evaporation from the surface is therefore intense—a fact which must have a considerable influence upon the vegetation of a district which has little standing water, and but little soil by which absorbed water may be retained, and which therefore depends for its water-supply upon dew and rainfall ; and the latter, as we have already seen, is, during the dry season, comparatively small in amount ; and what little there is, by reason of the undulation of the country and the hardness of the surface, tends to run off rather than be absorbed. Therefore the supply of water to the roots is small, and the necessity for the reduction of transpiration imperative ".

#### THE WET PATANAS.

The wet patanas occur from 4,500 to 8,000 feet elevation. They receive 75 to 125 inches of rainfall which is more evenly distributed and they experience both monsoons. The sun is often clouded so that the intensity of illumination is less. The

soil is rich in humus which varies in thickness from a few inches to a few feet, and it retains a considerable amount of water. The flora consists mainly of species of grasses of the same genera as in the dry patanas but here the growth is more luxuriant. Above 5,000 feet the flora is almost temperate; and above 6,000 feet the tufted grasses become more compact to form a coarse turf.

It is particularly in these wet patanas with their heavy, fairly evenly distributed rainfall and water-retaining soil that most can be expected from a pasture point of view. At Bopatalawa, 5,100 feet elevation, general observations have shown that burning tends to reduce the dominant *mana* which is relatively useless from a pasture point of view and increase the useful *pini-baru-tana*, *rat-tana* (Sinhalese) (*Ischaemum ciliare* Retz.), and other species.

#### THE EFFECT OF BURNING ON SUCCESSION.

In Ceylon no experimental data are available to indicate definitely the harmfulness or otherwise of this almost universal practice of burning. Trials are being conducted but from the very nature of the problem it will be many years before definite results can be obtained. A certain amount of work on similar problems has been done in other countries, particularly in South Africa, and a resumé of that work should, at this stage, be useful in giving helpful indications.

#### VELD BURNING IN SOUTH AFRICA.

J. W. Bews (4) writing on grassland succession in South Africa, states—“ . . . . In the more mesophytic [*i.e.*, fairly and continuously moist] areas of eastern South Africa there are three main stages of the grassland plant succession, if we begin with the dry open spaces . . . . the three stages are dominated respectively by—

- (a) Species of *Aristida*, *Eragrostis*, *Sporobolus*, *Cynodon*, &c.;
- (b) *Themeda triandra* with *Andropogon* spp.; and
- (c) *Cymbopogon* spp. with shrubs. The third stage is really, however, transitional to forest.

“It is only in the more mesophytic areas that the grassland plant succession in South Africa advances towards forest. Over great stretches of the high plateau, as well as over a good deal of Natal, *Themeda* represents the final stage. In drier areas the grasslands succession does not proceed beyond the first stage, and *Aristida* spp., &c., are dominant in the climax vegetation . . . .”

In certain areas of South Africa experiments showed that burning tended to improve the stock-carrying capacity of the grasslands whereas in other areas similar experiments gave an opposite result—the veld becoming poorer with regard to its

carrying capacity, so that some farmers maintained that burning was good and necessary while others contended that it was harmful and wasteful.

“The reason for these opposite results soon became apparent from a study of the question in relation to succession. Burning tends to throw back the succession, and if long continued it destroys the climax stages and the succession has to start afresh. Now on farms situated in mesophytic areas (forest areas), the Tambookie grasses (*Cymbopogon*) and accompanying shrubs—the third stage mentioned above—are more or less useless for stock. If these are burned, the earlier (*Themeda* and *Andropogon*) stage is, temporarily at least, established and provides good grazing. Farmers in such areas were therefore advised to continue the practice of burning, but to take care not to burn more often than necessary, lest in turn they might destroy the mesophytic grasses (*Themeda*, &c.) and bring in the pioneer wire grasses (*Aristida* spp., &c.).

“In drier areas over all the eastern high veld plateau, where the climax stage consists of *Themeda* and *Andropogon* spp., burning tends to destroy this also, and the pioneer stages, *Aristida*, *Eragrostis*, &c., take possession. These being xerophytic [living in and adapted to conditions of drought] are unpalatable to stock and of less value. In such areas farmers were advised not to burn the grass, but to graze it down or to cut it, so as to give the early growth in spring a chance to develop. Where *Aristida* spp. were already dominant the more mesophytic species might be re-established by discontinuing the practice of burning.

“An important result, therefore, of the work on grassland successions was not merely the satisfaction of reconciling conflicting opinions among farmers, but the ability to give detailed advice on grass veld treatment under the varying conditions which prevail over South Africa.”

#### BEARING OF THE WORK IN SOUTH AFRICA ON THE PROBLEM IN CEYLON.

Writing generally, from somewhat limited observation, in Ceylon, too, there are the same three main stages of grassland plant succession :

- (a) *Aristida* spp. (*et-tuttiri*) dominant;
- (b) *Themeda tremula* (*pini-baru-tana*), *Chrysopogon zeylanicus* Thw., *Arundinella* spp., *Ischaemum* spp., &c. dominant; and
- (c) *Cymbopogon confertiflorus* (*mana*) dominant.

The (a) *et-tuttiri* (*Aristida*) dominant grasslands are confined to the dry zone; large tracts of such may be seen about Polonnaruwa, and this stage does not occur in the patanas.

The *et-tuttiri* (*Aristida*) is an unpalatable, wiry grass, eaten by stock only in its very young stages, and, as in the case of South Africa, is more or less useless. Of greatest value from a stock-feed point of view is the (b) stage with *pini-baru-tana* (*Themeda tremula*), *Chrysopogon zeylanicus*, &c., dominant, as they are good, palatable grasses, while the (c) stage with *mana* (*Cymbopogon confertiflorus*) dominant is of very little value.

Now, if stage (c) grassland (*mana*) is burnt, and stage (b) (*pini-baru-tana*) is brought about, a valuable sward is obtained from what once used to be valueless. And it is the (c) (*mana*) stage which is commonest in the Ceylon patanas. On examination of frequently (probably once or twice a year) burnt patanas at Bopatalawa it is seen that the valuable (b) (*pini-baru-tana*) stage is now mainly present whereas in unburnt areas is found the (c) (*mana*) stage which is of very little value. Thus from a preliminary examination alone, burning can be recommended in similar localities where the *mana* (c) stage is dominant. Nor is there any fear of the useless *et-tuttiri* (a) stage being brought to occur as, with judicious burning, the environment is too favourable for such a climax to form.

#### VELD BURNING FOR SOUR-VELD MANAGEMENT.

J. W. Rowland (5) mentions a practical aspect of grassland burning which is of interest. "In the sour veld, especially where haymaking and ploughing for supplementary feeding are not practised, fire is used for the control of grazing. The veld alone in this country is not sufficiently nutritious in the mature state to support livestock, but the system of farming is so regulated that there is constantly an area where young short shoots are available for grazing owing to regrowth after the burn. The accompanying diagram shows the system :—

Area A—Burn August, 1935 ; Burn February, 1937 ; Burn August, 1938.

Area B—Burn February, 1936 ; Burn August, 1937 ; Burn February, 1939.

Area C—Burn August, 1936 ; Burn February, 1938 ; Burn August, 1939.

"By this method, for example, a portion (A) of the area to be grazed is burned in August, 1935. This is grazed through the ensuing spring and summer by both sheep and cattle. During February and March, 1936, another area (B) is burned for late summer and winter grazing. During the winter of 1936, in August another area (C) is burned for grazing in spring and summer 1936 to 1937. In late summer (February) area A is burned for autumn and winter grazing. Area B is burned in winter 1937 and in the following autumn area C is burned again.

"Under such a system fencing is scarcely necessary. During November, December and January, the grazing is of good quality, but is very poor in winter and only fair in late summer

“Only very incomplete utilization of herbage is feasible by these methods, and it is found that under heavy stocking the veld deteriorates rapidly.

“With a few animals on a comparatively large area, a large proportion of the veld matures, and each section, owing to its growing out after burning, and the two years’ interval between each burning, has ample chance to maintain a vigorous root system.

“Where land is very sour and economic conditions make it unwise to put much capital into land development, the system may be justified, since it definitely renders possible the running of livestock on this land for twelve months out of twelve, and the veld is stable and does not deteriorate.”

Apparently with the large extent of patana land available, a modification of this system of rotational grazing without fencing is the most likely to be adopted in Ceylon for many years to come. The great advantage is that there is feed during the whole year. Another greatly to be appreciated advantage, particularly at a time like the present when barbed wire is almost unobtainable, is that no fencing is required. The disadvantage of this method is that so much herbage is wasted. But under present conditions, in any case, owing to the paucity of grazing animals available, a large proportion runs to waste. When, however, intensive methods are introduced, no doubt a more suitable system will be evolved.

#### PATANA BURNING AND ITS EFFECTS ON THE LAND.

The advantages and disadvantages of burning veld in South Africa are discussed by W. R. Thompson (6). The advantages of burning are :—

(1) It helps in removal of dry and accumulated organic matter which not only prevents the accessibility of what tender growth is available but also actually reduces the quantity produced.

(2) Veld unburnt over long periods not only increases in the amount of useless shrubs and other unpalatable plants “ but often induces inferior grazing. Desirable species of grasses either disappear entirely or become stunted in growth, being replaced by useless shrubs and other forms of vegetation of doubtful value.”

(3) It prevents growth of shrubs and other useless plants.

(4) It helps in the permanent prevention of fires. If grown over long periods the grass will at most times burn and there is the ever present danger of accidental burning.

(5) Burning kills off ticks and similar insects and thus prevents the spreading of tick-borne diseases. There is some difference of opinion on this as the effects are purely temporary.

In this respect the effects, however, are distinctly seen at Bopatalawa, where in November, 1942, patana burnt over at

least three years ago is heavily infected with ticks whereas that burnt in December, 1941, and later, is free of ticks. How far under Ceylon conditions burning is effective in controlling ticks has to be determined but this preliminary observation deserves mention here.

(6) Burning is advocated towards the end of the active period of growth as this tends to encourage new grass growth and so prolongs the grazing period.

The disadvantages of burning are :—

(1) Soil erosion is increased.

(2) Under certain conditions, undesirable ecological changes are brought about in the sward.

(3) Soil fertility may be adversely affected.

(4) Moisture content of the soil may be lessened.

(5) Soil temperatures are increased.

(6) It is responsible for mortality in desirable insects and other animals including superficial soil organisms.

Considering the advantages and disadvantages as a whole and applying them to Ceylon conditions, the former certainly are preponderant. But each case must be considered on its own merits, depending particularly on climax stage, climate, soil and lie of land.

#### THE PROBLEM OF SOIL EROSION.

The chief, and perhaps the only really noteworthy, objection to burning has been that it causes soil erosion and this aspect deserves fuller consideration. The present state of our knowledge of soil erosion has been summarized in a simple and lucid manner by G. V. Jacks (7) who states :—

“ The cause of soil erosion is often given as the destruction of the natural vegetation which normally affords the soil adequate protection from the erosive action of rain and wind. This is correct up to a point, but there is no reason why the destruction of the natural vegetation, whether forest or grassland, should necessarily be harmful. All agriculture involves such destruction, and it stands to reason that no permanent agriculture is possible where the soil is progressively deteriorating. The real cause of erosion is the practice of an agriculture which does not take full account of the natural limitations of the environment and causes soil exhaustion, which is the invariable precursor of soil erosion. Soil in a high state of fertility rarely erodes, even when stripped of vegetation, and the only certain cure for soil erosion is to utilize the land in a manner which maintains, and preferably increases, its fertility. Such a type of land utilization is general in the highly farmed countries of Western Europe, where, despite prolonged and intensive agriculture, the soils are probably now capable of

greater and more sustained production than at any previous time. The agriculture of the Middle Ages was, like the present-day agriculture of much of the New World, soil-exhausting, and might ultimately have caused widespread erosion had it not been put on an entirely new basis by the agricultural revolutions of the seventeenth and eighteenth centuries. These resulted in a type of agriculture that, so far as the maintenance of soil fertility was concerned, made the optimal use of the natural qualities of the environment.

“In the eroding countries of the New World a comparable harmony between agriculture and the environment does not exist; erosion is, indeed, the most common physical symptom of an absence of such harmony . . . . The factors, chief among which is the climate, that determine how the soil must be cultivated so as to increase its fertility are still largely outside human control . . . .”

“On the other hand, the factor which determines how the land actually is utilized is primarily economic. In general, men will always cultivate the land in the way that gives them the greatest economic advantage, and soil-exhausting agriculture, which implies drawing on the existing fertility reserves, tends to be easier and more immediately profitable than soil-conserving agriculture, which implies investing something in the land to pay a dividend at a later date. Consequently, although the measures required to stop erosion and build up soil fertility are simple and understood everywhere, they are not applied on a scale commensurate with the task unless and until the economic conditions of a country make it more profitable to conserve than to exhaust the soil. The first essential step in the soil-conserving agricultural revolution in Britain—the enclosure and pasturing of exhausted arable land—was promoted by the prosperity of the wool trade and the contemporary depression of the grain trade . . . . American economy is developing along lines which are making it more profitable to make than to destroy soil fertility. Provided future developments are in the same direction, the problem of soil erosion will solve itself.

“ . . . . The necessary requisites for the accomplishment of soil conservation in an eroding region are thus, firstly, an economic system under which it is more profitable to make than to destroy soil fertility, and secondly and complementarily, a form of society that can work the economic system . . . .”

In Ceylon, regulated burning of the wet patanas for later pasturing of stock brings about a biotic equilibrium, increasing soil fertility and fulfils the requisite conditions for preventing erosion. This, perhaps, explains why oft-burnt patanas go on producing good feed without showing any signs of greater erosion than coarse, unburnt patanas of little use for pasture, in comparable situations.

Stimulated by the burn, the grass shoots up and the quick rate of growth is kept up by the fertility of the soil, so that in a short time a new and complete ground cover is formed. Thus at Bopatalawa (wet patanas, 5,100 feet elevation) in patana burnt on August 8, 1942, the grass was 6 to 8 inches high on September 2 (*i.e.*, in a little over 3 weeks. Plate II., photograph 1), and 12 to 16 inches high by November 2 (3 months) when, practically no bare ground was left exposed to the direct beating action of the falling rain of the oncoming North-East Monsoon.

#### THE TIME OF YEAR AND FREQUENCY OF BURNING.

The time of year at which burning should take place is an important aspect of the problem. In general, burning should be done when the soil is moist, after a few showers of rain, but well in advance of the heavier rains, so that the grass would have grown and covered the ground, thus preventing direct beating of the rain on bare soil, when the heavy rains occur. In patana burnt in such a manner, soil erosion is negligible. On the other hand, if patana is burnt at the commencement of the heavier rains, bare ground is exposed to the direct action of the falling raindrops and appreciable soil erosion would result. Burning in the latter case is definitely harmful and is condemned. But, timely burning is beneficial.

At any time, burning stimulates the grass to new growth, so that burning can be regulated to provide fresh food throughout the year. Nevertheless plants cannot be forced to grow at too frequent intervals because they must be allowed to store food so that they are not exhausted or given too severe a setback by untimely forced growth.

A well regulated system has to be devised and this can only be done after *ad hoc* experiments have been carried out to determine the most favourable times and frequencies of burning under the various conditions present.

Having generalized, it is well now to consider some specific observations.

#### SOME OBSERVATIONS AT BOPATALAWA.

Bopatalawa is in the wet patanas, at an elevation of 5,100 feet, with an almost temperate climate, and receiving an average annual rainfall of 104 inches in 204 days, distributed as follows :

Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
4"	2.5"	6"	10"	9"	13"	11"	9"	9"	13"	10"	8"

With regard to patana burning, no earlier history of the place has been recorded, but it is unlikely that any patana there, has not been burnt within 3 to 4 years. Preliminary observations have been made and *ad hoc* experiments are being laid down there. To give a clear idea, complementary photographs (Plates I.-IV.) showing some features of interest are added. All the photographs were taken on September 2, 1942.

## PLATE I.

*Photograph 1* shows a patana burnt on August 8, 1942; and an unburnt area on the near side of the stream; and in the distance, patana with forest on either side.

In *photograph 2*, another part of the area burnt on the same date is seen in the mid-distance, abutting in front on an area burnt earlier in the year and now covered with grass; in the latter the large tufts scattered in the valley to the right are *mana*; in the background is forest. Most of the grass is *pini-baru-tana*, and *Chrysopogon zeylanicus*. There is some bracken (*Pteridium aquilinum* (L.) Kuhn) scattered among the grass, more densely just behind the *mana* near the bank of the stream.

## PLATE II.

*Photograph 1* shows a near view of the burnt area shown in Plate I, photograph 1. The large tufts of grass near the bank of the stream (and scattered in the valley on the right in Plate I, photograph 2) are *mana*. Such areas often escape the burn, and they are also more favourably situated, so that the higher climax stage (useless for pasture) continues. Near the bank is seen unburnt *mana* mixed with bracken, and the leguminous shrub *et-tora* (Sinhalese) (*Atylosia trinervia* (Spr.) Gamble). Bordering the stream are a few clumps of *ela-mal* (Sinhalese) (*Hedychium flavescens* Carey). Scattered behind, in the patana proper, are a few burnt *mana* tufts (larger than the rest) among the numerous, close and smaller tufts which are *pini-baru-tana* (*Themeda*), *Chrysopogon zeylanicus*, *Arundinella* spp., *Pollinia* spp., &c. The grass which was burnt on August 8, 1942, has grown 6 to 8 inches high by September 2, and 12 to 16 inches high by November 2.

*Photograph 2* shows an unburnt (recently) patana on low flat land on the nearside of, and bordering the stream. It gives an idea of the vegetation before burning of patana similar to that shown in photograph 1. The dominant grasses are *pini-baru-tana* (*Themeda*), *Chrysopogon zeylanicus*, &c. Bracken occurs scattered about. The fringe of taller vegetation in the background borders the stream.

Soil erosion to any appreciable extent was not observed in the burnt plots up to November 2, 1942, by when the soil was fully covered with growth of vegetation.

## PLATE III.

*Photograph 1.*

Foreground: patana burnt on December 26, 1941.

Mid-distance: patana burnt on July 20, 1942.

On right, wedged between the two: patana burnt on August 8, 1942.

Background: patana with forest on either side.



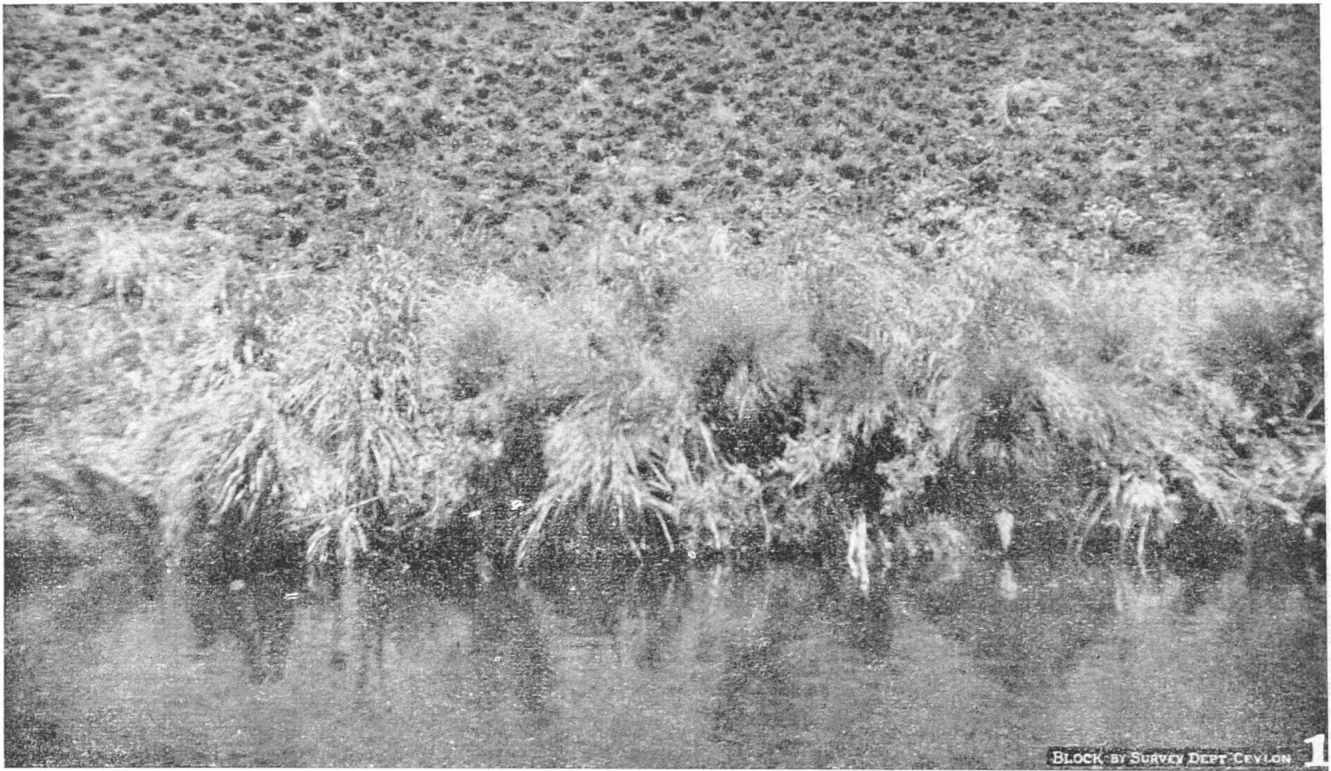
*Photo by J. E. Senaratna, 2.ix.1942.*

Plate I.—Photograph 1. Bopatalawa Patanas. Patana burnt on August 8, 1942 (mid-distance).



*Photo by J. E. Senaratna, 2.ix.1942.*

Plate I.—Photograph 2. Bopatalawa Patanas. Patana burnt on August 8, 1942, abutting in front on an area burnt earlier in the year.



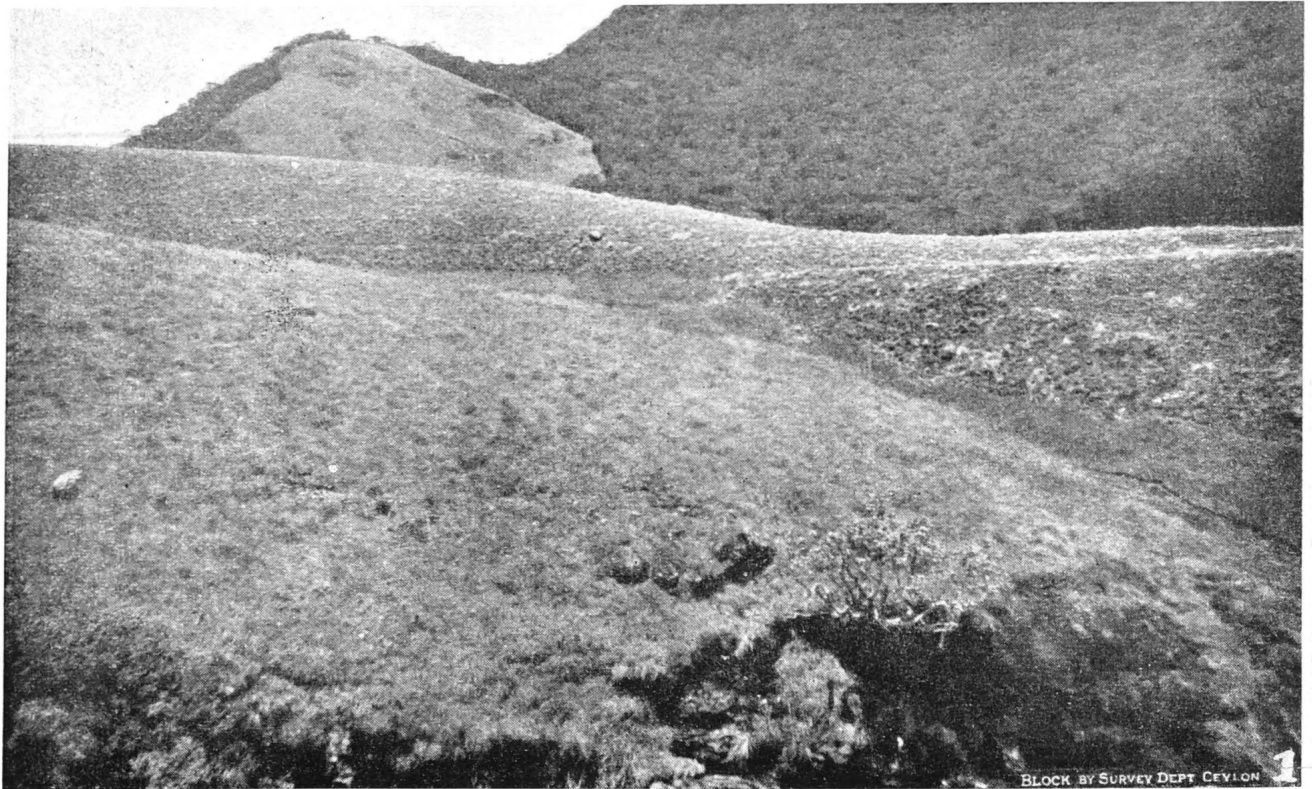
*Photo by J. E. Senaratna, 2.ix.1942.*

Plate II.—Photograph 1. Bopatalawa Patanas. Near view of area burnt on August 8, 1942 (Plate I., photograph 1).



*Photo by J. E. Senaratna 2.ix.1942.*

Plate II.—Photograph 2. Bopatalawa Patanas. Unburnt (recently) patana on near side by the stream.



BLOCK BY SURVEY DEPT CEYLON

*Photo by J. E. Senaratna, 2. ix. 1942.*

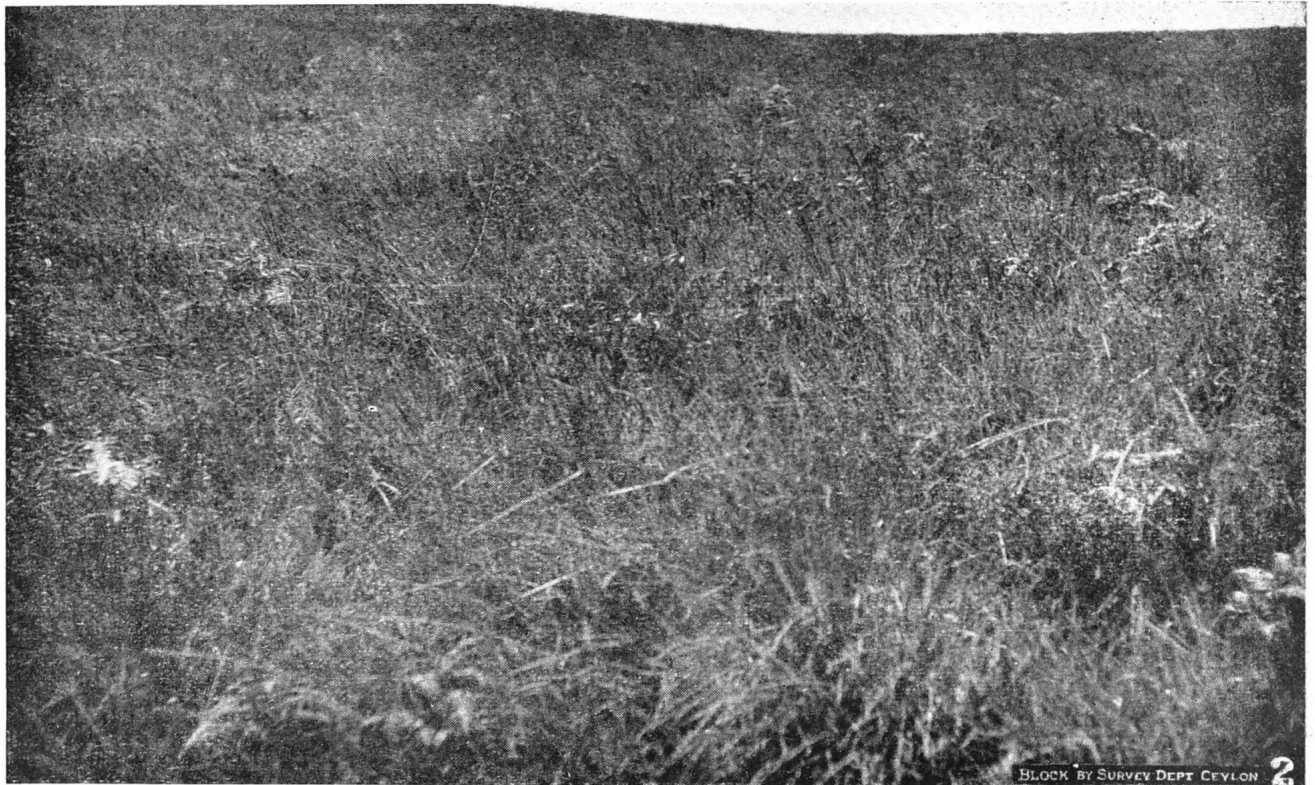
Plate III.—Photograph 1. Bopatalawa Patanas.

Foreground : Patana burnt on December 26, 1941.

Mid-distance : Patana burnt on July 20, 1942.

On right, wedged between the two patana burnt on August 8, 1942.

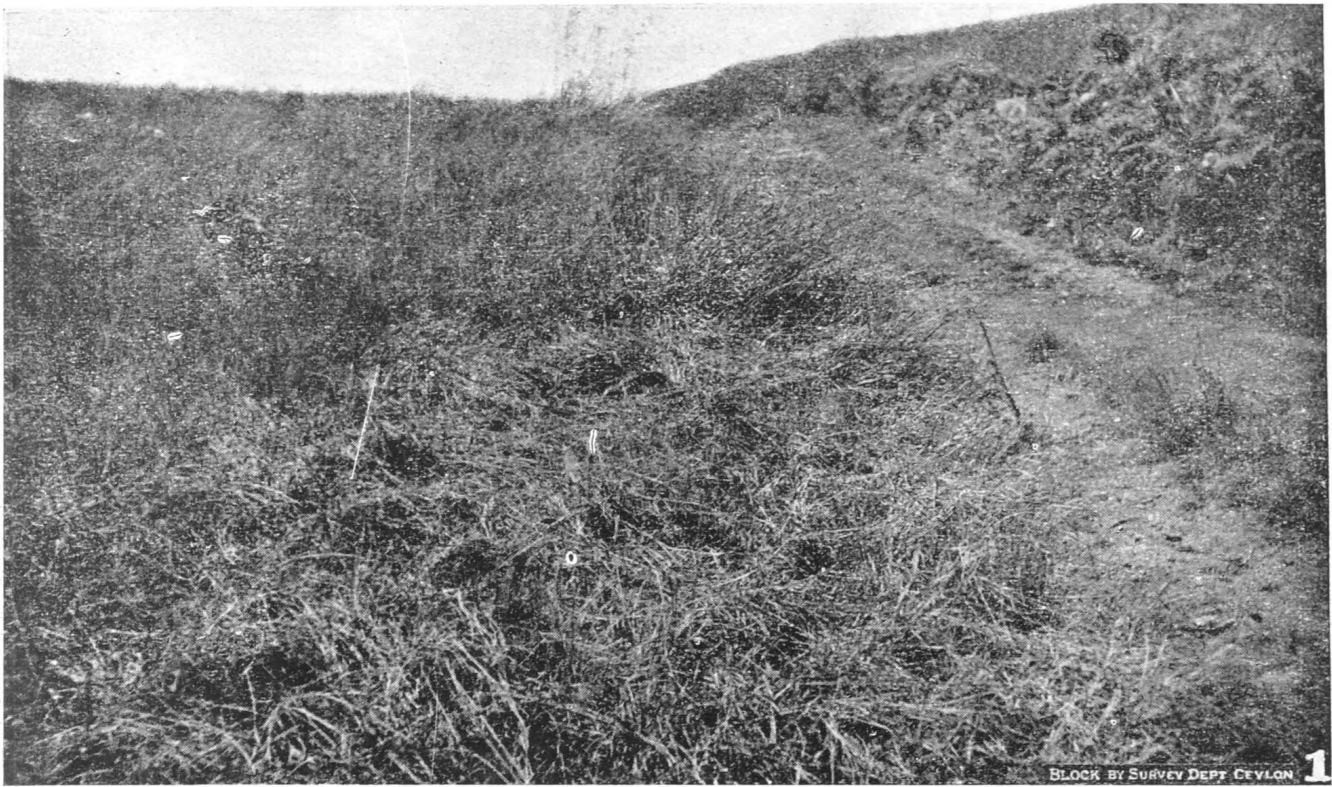
Background : Patana with forest on either side.



BLOCK BY SURVEY DEPT CEYLON

*Photo by J. E. Senaratna, 2. ix. 1942.*

Plate III.—Photograph 2. Bopatalawa Patanas. Unburnt (recently) patana on hillside.



*Photo by J. E. Senaratna, 2. ix. 1942.*

Plate IV.—Photograph 1. Bopatalawa Patanas. Unburnt (recently) patana with the grass in the foreground cut off to show the undecayed, fibrous layer on the ground.



*Photo by J. E. Senaratna, 2. ix. 1942.*

Plate IV.—Photograph 2. Bopatalawa Patanas. Regrowth of grass two months after cutting of a patana similar to that in photograph 1 above.

*Photograph 2* shows patana on a sloping hillside, in the experimental pasture area, which has not been burnt within at least two years. The dominant grasses are *pini-baru-tana* (*Themeda*), *Chrysopogon zeylanicus*, &c. with *rat-tana* (*Ischaemum ciliare* Retz.) ; and bracken plants every 6 feet or so. (cf. Plate II. photograph 2.)

#### PLATE IV.

*Photograph 1* shows the same type of unburnt patana as Plate III., photograph 2, but with the grass in the foreground cut off to show the undecayed layer over 2 inches thick of dry, fibrous material on the ground.

*Photograph 2* shows regrowth about 2 months after cutting, in the same type of patana shown in photograph 1. The grasses are just coming into flower while in the adjoining uncut area (not shown) there are still no signs of flowering.

It should be pointed out that in cutting off the grass, a part of the mineral salts absorbed by the plants is removed with the cut parts of the plants and so is lost to the soil which provided it, whereas in burning, it is returned to the soil in the form of ash, *i.e.*, fertility, at least with regard to mineral salts, is depleted in cutting, but maintained in burning.

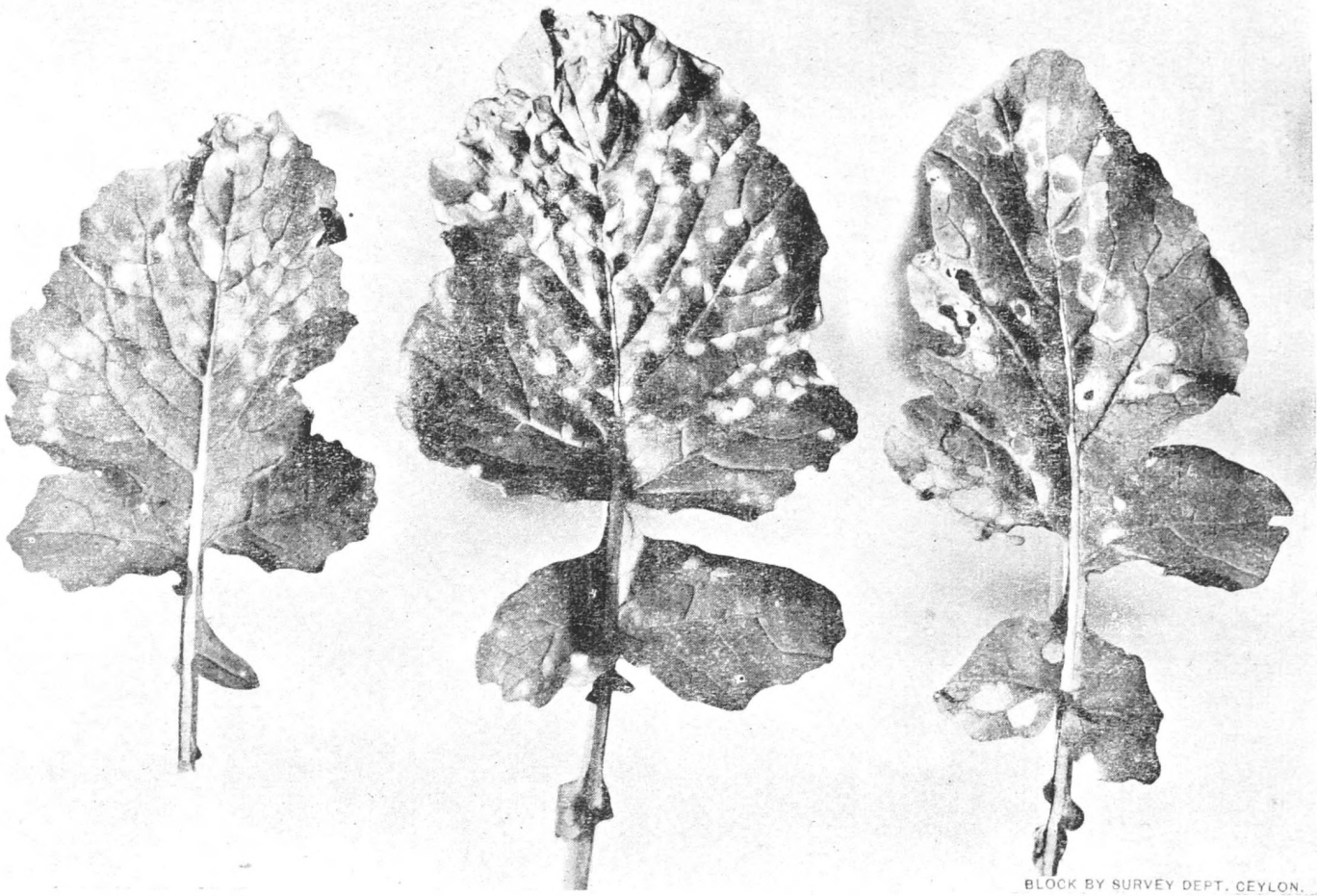
#### CONCLUSIONS.

Burning of patanas has gone on from ancient times chiefly for providing fresh pasturage for stock. It has been condemned from time to time as causing soil erosion, but, the alleged harmful effects of burning are, in fact, open to question. The problem is really one of succession. There are two main stages of grassland succession in the patanas. The earlier, useful *pini-baru-tana* (*Themeda*), &c. climax, and the later, useless *mana* (*Cymbopogon*) climax. If patanas, in the latter climax stage are burnt and the former is brought about, a useful sward is obtained from what once used to be valueless. Thus from preliminary observation alone burning is recommended in wet patanas with the *mana* climax.

In Ceylon no experimental data are available with regard to burning of patanas. A certain amount of experimental results are available on burning veld in South Africa. Some of this work has been considered, particularly in relation to the Ceylon problem. The advantages and disadvantages of burning are pointed out. The main objection is that burning causes soil erosion. In the wet patanas, at least, it is shown that this objection does not hold in the case of regulated burning. The time of year and frequency of burning are important factors, and the most favourable times and frequencies have to be determined by *ad hoc* experiments. Preliminary observations at Bopatalawa (illustrated with photographs) confirm the view that regulated burning is beneficial.

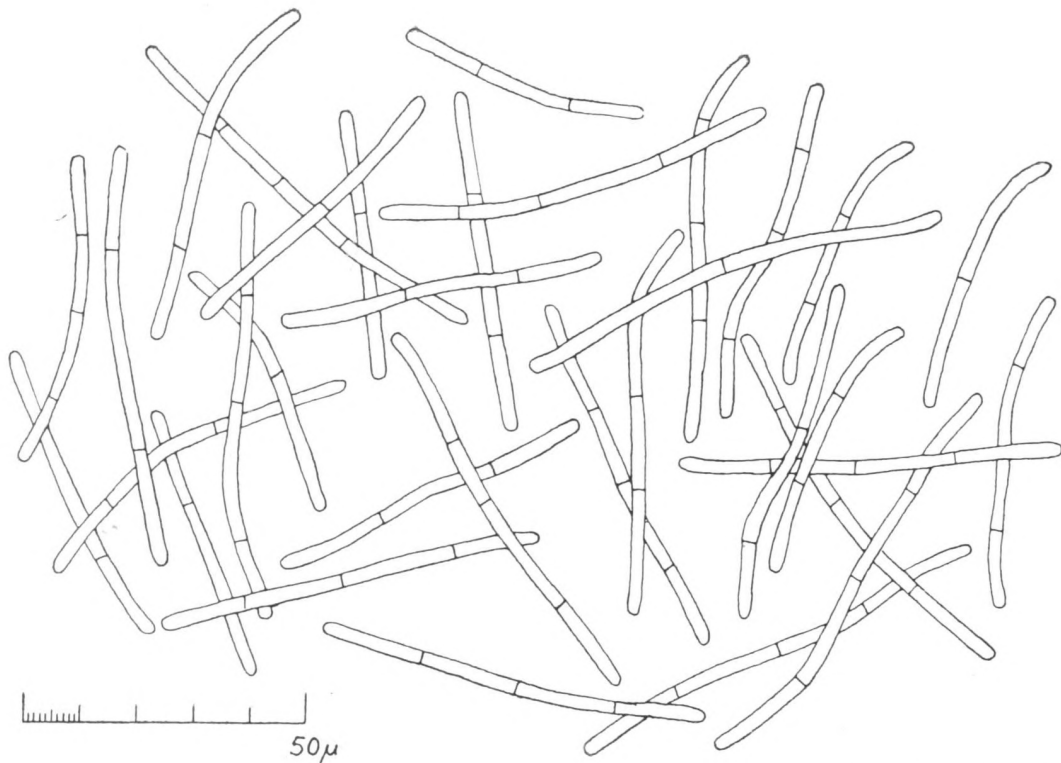
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BLOCK BY SURVEY DEPT. CEYLON.

Fig. 1.—Turnip leaves showing symptoms of "white spot" disease.



BLOCK BY SURVEY DEPT. CEYLON.

Fig. 2.—Fresh spores of *Cercospora brassicae* (Fautr. and Roum.) von Hoehn. in water (Camera lucida drawing  $\times 575$ ).