From: Chief, Smallpox Eradication

To: Smallpox Staff

Subject: Progress Report 24 - Target Zero 31 July 1974

1.0 Introduction

Smallpox incidence is now declining in all endemic areas. While for all of us, this is encouraging, it is no cause for complacency. The important question now is to whether or not we can reach sufficiently low levels by end September to permit the implementation of the final phase of the campaign. At best, the task will not be an easy one - constant reappraisal of progress and appropriate redeployment of personnel will be required. To assess relative progress in the different areas, an effort has been made (section 2.0) to set guidelines in regard to expected incidence each week for the different areas in Asia. So far, the results are encouraging but far from decisive. The next 8 weeks will tell the tale.

In Ethiopia, similar curves cannot be constructed due to the total inaccessibility of so many of the rural areas during the summer months. However, programme staff in Ethiopia are confident that by end August, smallpox will be entirely confined to portions of four provinces in the central highlands with no area extensively infected. In October, two helicopters will be deployed in a final search and destroy mission which the staff has termed - "Operation Crocodile".

2.0 Targets for the Final Phase - Asia

As we proceed in the count down to 'zero', there will be a greater need than ever before to follow closely progress in the various areas so as to assure, to the extent possible, that there is an optimal deployment of forces. Deciding what the targets should be is not an easy matter. The following, based on discussions with programme staff in Delhi and Karachi, is an effort to set forth the targets for Asia in specific terms which may assist in planning as the year progresses.

You will recall that targets were discussed last autumn but these proved to be too optimistic. In defining new targets, a critical look at previous expectations is important to sense whether we were anticipating too much or whether there were factors specific to the subcontinent which were not fully appraised and understood. While I believe both may have played a role, I sense that we (or better I) under-estimated the potential of smallpox transmission in Asia during the November to May period. Our previous experience in regard to what effect might be obtained with intensive programme activity had primarily been acquired in South America, Africa and Indonesia. Population densities in most areas were far less, although Indonesia was a notable exception. Population movement in these other areas was, I suspect, less extensive that what one finds on the subcontinent where inexpensive train services are extensively used and marriage parties, fairs, festivals and the like seem more numerous and well-

attended by more persons from near and far. And, finally, many of the previously endemic areas have a less marked fluctuation in temperature and relative humidity during the year and also a less marked seasonal variation in smallpox incidence than in Asia (see section 3.0). Endemic areas with temperatures as low as those in northern India and with as low a relative humidity have been comparatively few during the past 8 years.

The period between July and September is clearly the most optimal for smallpox control in Asia. High temperatures, high relative humidity and sharply diminished population movement persist with little change throughout most of the endemic areas until at least late September. The objective, therefore, must be to eliminate the maximum possible number of foci by that time. Such is the rationale for the intensive monsoon campaign. If few enough foci remain, sufficient staff and supervision should be available for the October - December period to deal with known remaining foci during this period when the rates of transmission begin to increase and effective containment becomes increasingly more difficult. However, if we are to be successful in reaching zero by June 1975, the number of infected villages remaining at end December must be few indeed for between January and April, as we have seen, smallpox can spread more explosively than in virtually any area which has been endemic during the past 8 years.

Our immediate goals, it was felt, should be expressed in terms of the numbers of villages/municipal wards in which one or more cases have occurred during the preceeding four weeks ("active foci") and so require regular follow-up to insure that containment measures have been effective. As of 14 June, there were 8 086 known "active foci" in India, Pakistan and Bangladesh. We must assume that some existed which were not known and thus, at approximately the peak of the smallpox season, we might guess that there were perhaps 10 000 "active foci".

Seasonal factors normally result in a decrease in cases to a level in September which is one-eighth to one-tenth the incidence observed at the peak of the season. Assuming that the number of "active foci" decreases in a comparable ratio, we might expect seasonal factors to reduce the number of foci to the level of 1 000 to 1 250 by end September. The intensive activities of the monsoon campaign should have a further effect in reducing this number. We believe, reasonably, we should be able to reach the level of 750 active foci by this time. If this is achieved, the 100+ epidemiologists employed would be required to supervise the investigation and containment of an average of only 7.5 foci each - a task which field staff feel to be entirely reasonable. With increased attention directed to far fewer foci from the end of the monsoon season onwards, there would seem to be every reason to expect essentially complete elimination of all active foci by the end of the year. Undoubtedly, hidden foci will emerge after this time but experience would indicate that they should be few in number thus permitting each to be dealt with as an all-out emergency.

What then should be our objectives state by state and country by country by the end of September?

Pakistan (Target - 0). Present trends indicate interruption of transmission by the end of August and programme staff are confident this goal can and will be met.

Bangladesh (Target - 50). At end June, there were 584 active foci. Programme staff are hoping, in fact, to reach the goal of 50 by late August.

India - Eastern wing (Target - 15). At end July, there were 101 active foci with intensive programmes now in progress in all States.

West Bengal (Target - 45). On 13 June, there were 436 active foci, half of which represented importations from Bihar. West Bengal's success thus depends largely on progress in Bihar.

Bihar (Target 450). Approximately 4 000 foci were known on 21 June.

Uttar Pradesh (Target - 180). Approximately 1 700 foci were known on 21 June.

Other States (Target - 10). Approximately 120 were present at end June, many of which represented importations. Those in September would all be importations assuming the targets are met.

While appraisal of numbers of remaining active foci are now followed weekly, if not daily, in virtually all Districts, this information is not regularly forwarded to Delhi or Geneva nor have all been requested to do so. This we would hope soon to regularize. In the interim, we have endeavoured to determine what is the relationship between numbers of cases reported and number of foci. Earlier in the year the number of cases per focus was as high as 6 to 8 in some areas. In recent months the total has fallen. At present, a reasonably close approximation of number of foci can be obtained by dividing the number of cases over the preceeding 4 weeks by four. Thus, if 2 000 cases have been recorded during the preceeding 4 weeks in an area, one may assume there are approximately 500 foci with one or more cases during the preceeding four weeks.

With this assumption, targets have been constructed based on numbers of cases per week. Week 20 was in part arbitrarily selected as the seasonal peak week in incidence and the average of cases for weeks 19, 20 and 21 shown as the initial point on a curve. The expected September incidence was calculated on the basis of the targets noted above and a straight line curve on log paper was used to connect the points. The lines were interrupted at the level of 25 cases as it is assumed that when the incidence reaches this level the speed of decline would be more rapid.

As may be seen from the figures attached, the slope of all curves is approximately the same and in most areas, the actual curves show the programme to be on schedule or slightly ahead of schedule. These include Bangladesh, India (Other States), Bihar and West Bengal. Pakistan's increase in incidence during week 30 coincides with a special search week during which a number of healed but previously unreported cases were detected. The states of the Eastern wing of India appear to be lagging behind but the numbers on which calculations are based are small and, in fact, progress at the moment appears to be excellent. The single area which appears now to be lagging significantly behind schedule is Uttar Pradesh. This may reflect the discovery of cases during a search week (week 29) but one must note that incidence each week for the last six weeks has been consistently above expected values.

The question now is not whether smallpox incidence is declining, for certainly it is in all areas - the question is whether or not is it declining rapidly enough. This we will all need to follow with care in the coming months.

3.0 The effect of temperature and humidity on smallpox transmission

The decrease in smallpox incidence as temperatures rise and the summer rains begin is a well-known phenomenon. This fall in incidence reflects the decreased likelihood that a smallpox patient will transmit infection to one or more with whom he is in contact. Several factors may play a role. Problems of travel and a decrease in social events during the summer months such as marriages, fairs and festivals, decrease the number of contacts which a patient may have. Fewer contacts mean fewer persons effectively exposed to infection.

A second factor believed to be of considerable importance, however, is the effect of temperature and humidity on the survival of the virus when suspended in an aerosol. Since transmission depends on a susceptible contact inhaling virus particles excreted by a patient, it stands to reason that the more virus particles which are suspended in the air, the more likely it is that the contact will be infected.

In 1961, Harper published an article in the Journal of Hygiene showing the relative duration of survival of vaccinia virus particles when suspended in the air under different conditions of temperature and relative humidity. Variola virus presumably would behave in a similar manner. Data from this article have been utilized to construct the figure attached. Note that at 11°C (52°F) and 21% relative humidity, virus particles survive in the aerosol at high levels of concentration for 23 hours. An increase in temperature reduces the survival time and an increase in humidity further reduces survival time. The contrast between a winter temperature and humidity (11°C, 20% relative humidity) and a summer one (32°C, 80% relative humidity) is dramatic.

A third factor of importance is ultra-violet light which also serves to destroy aerosolized virus rapidly. The relative effect of this in winter and summer has not been measured, however.

While all of this is of theoretical interest, it may help to make the temperature and humidity of the present summer more tolerable!

4.0 Number of infected villages

Bangladesh		Date
Rangpur District	135	30 June
Rajshahi District	113	"
Mymensingh District	254	"
All others	85	"
Pakistan		
Punjab Province	35	18 July
Sind Province	47	"
All others	8	"
India		
Bihar	4 177	22 June
Uttar Pradesh	1 669	"
West Bengal	436	15 June
Madhya Pradesh	47	13 July
Assam	87	31 July
All others	76	15 June
TOTAL	7 169	

The total when last assessed on 14 June was 8086 but this figure inadvertently was understated by perhaps 1000-1500. The present figure of 7169 is, if anything, on the high side for certain of the areas because of variations in reporting.

5.0 Districts recording 100 or more cases in a given month

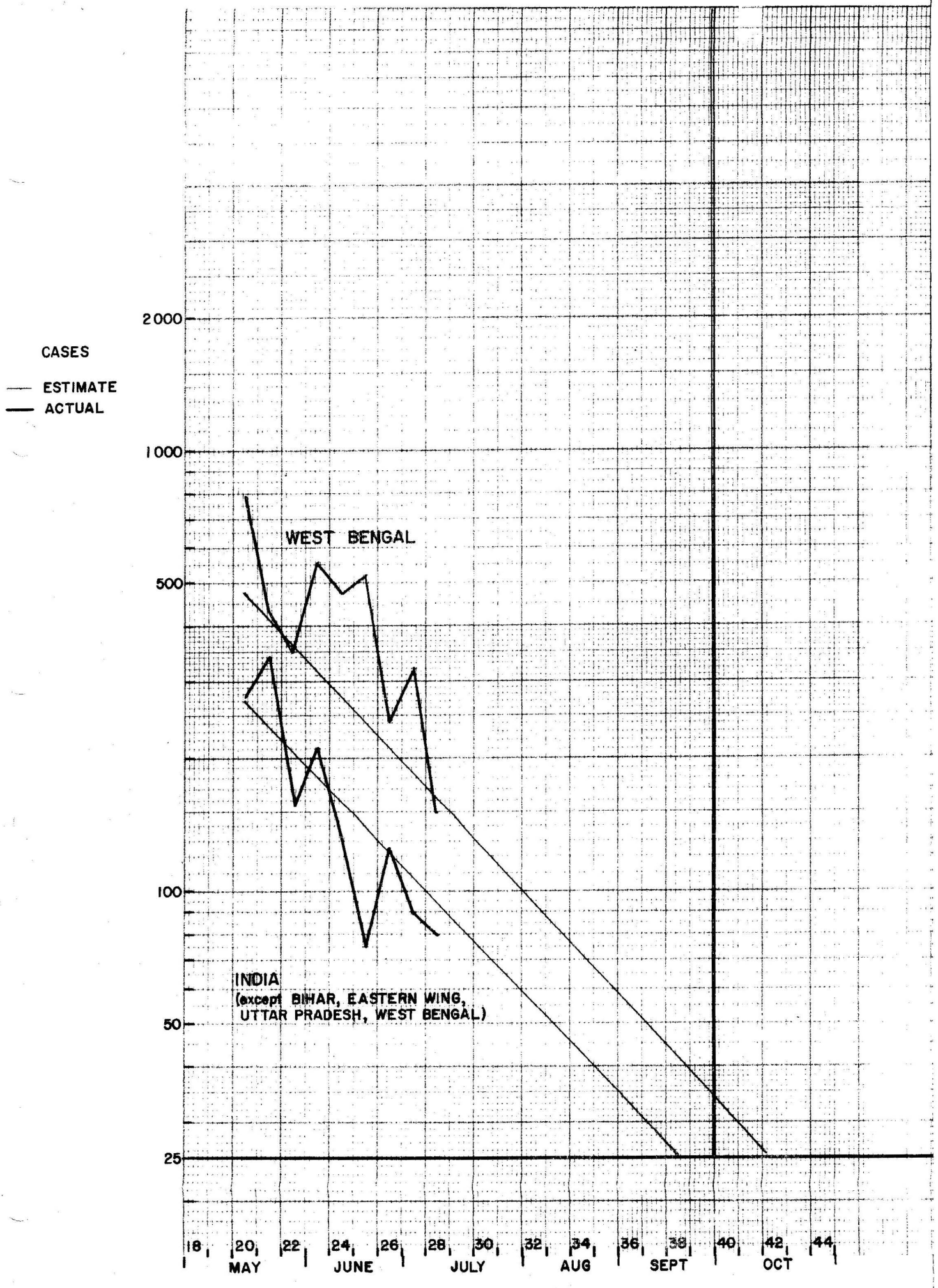
	Jan.	Feb.	Mar.	Apr.	May	June	July
India							
Bihar	13	19	22	21	31	26	30
Uttar Pradesh	10	5	13	14	22	21	20
West Bengal	3	2	7	8	6	5	2
Assam	0	1	1	~~2~~ 3	4	2	2
Madhya Pradesh	1	0	1	1	1	0	1
Orissa	0	0	1	1	1	0	0
Jammu and Kashmir	1	0	0	0	0	0	0
Maharashtra	1	0	0	0	0	0	0
Meghalaya	1	0	0	0	1	0	0
Bangladesh	4	5	5	5	5	~~4~~ 5	3
Pakistan	3	3	3	3	3	2	1
Ethiopia	2	2	3	2	2	1	1
Nepal	0	0	0	0	1	0	0
	39	37	56	~~57~~ 58	77	~~61~~ 62	60

Between May and June, the number of cases decreased by half but those reporting 100 or more cases by only 16 - from 77 to 61. It is noted that 47 of these 61 Districts (77%) are located in the two Indian States of Bihar and Uttar Pradesh - now rapidly becoming famous as the world's smallpox centre.

6.0 The world's 10 most heavily infected Districts - June

Bihar in June accounted for all 10 of the world's most heavily infected Districts. These 10 Districts alone accounted for 38% of the world's recorded cases of smallpox.

Rank	Country	State	District	No. of cases
1	India	Bihar	1 Purnea	~~2 242~~ 1902
2			2 DHANBAD	1093
3			3 Monghyr	~~1 696~~ 1052
4			6 Dumka	~~1 275~~ 680
5			8 Bhagalpur	~~989~~ 639
6			4 Katihar	~~981~~ 885
7			~~Singhbum~~	~~962~~
8			7 Saharsa	~~767~~ 653
9			~~Patna~~	~~625~~
10			5 Gaya	~~625~~ 691
			9 Ranchi	~~611~~ 618
10		Uttar Pradesh	10 Barabanki	523


CASES
ESTIMATE
ACTUAL
2000
1000
500
100
50
25
WEST BENGAL
INDIA
(except BIHAR, EASTERN WING,
UTTAR PRADESH, WEST BENGAL)
18
20
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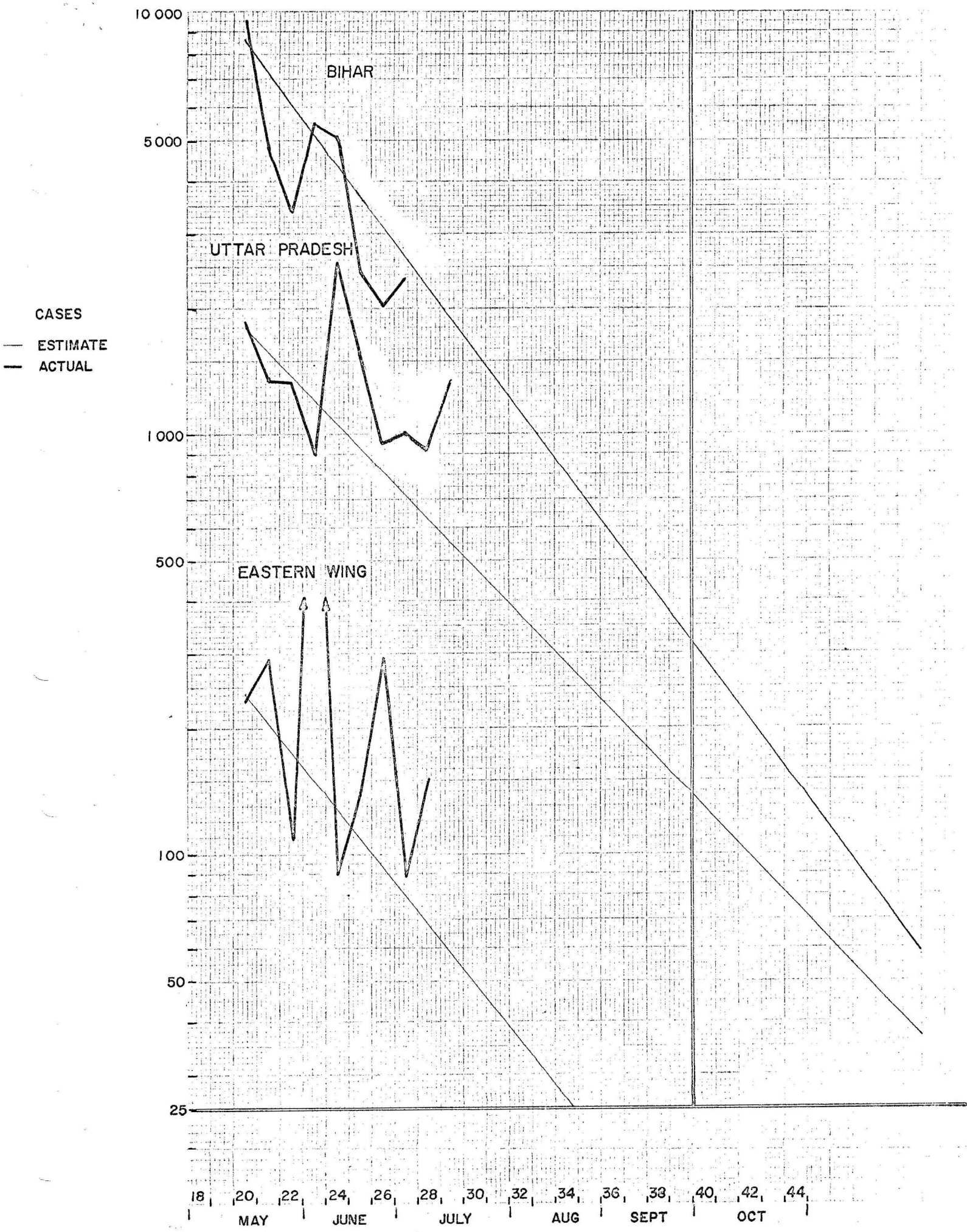
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