

A FRESH CYCLE OF THE DESERT LOCUST IN INDIA

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INTRODUCTION

BEFORE describing the events, associated with the initiation of a fresh locust cycle in India in the summer of 1940, a brief account of the history of the previous locust visitations and main features in locust biology should be of interest to the readers of *Current Science*. There are several species of locusts found in India, but of these, the desert locust, *Schistocerca gregaria* Forsk. is the most important. India has been, from times immemorial, subject to periodical visitations of locust swarms. In Sanskrit literature of the third or fourth century there is a mention of locust menace being one of the most serious calamities that cultivators had to face. Comparatively authentic records of locust visitation are however available only since the beginning of the nineteenth century and according to Cotes (1891) outbreaks occurred in 1812, 1821, 1834, 1843, 1863, 1869, 1878 and 1889. There was another cycle in 1896-97 and in the present century there have been serious invasions of the locust in 1901-03, 1906-07, 1912-15 and 1926-31. Thus there is a certain amount of periodicity in locust outbreaks when swarms appear and cause incalculable damage and destruction to crops, resulting sometimes in severe famines. Due to lack of fodder and pasture, there is heavy mortality among cattle, goats and sheep and sometimes people have to quit their homes in search of livelihood elsewhere. A moderate estimate of damage caused to crops alone during the last cycle (1926-31) was about 2 crores of rupees. Locusts usually remain active for several years in succession, ranging from 3-8 years. Generally their depredations are confined to north-western India but in some years, as during the last invasion of 1926-31, the swarms spread as far as Bengal and Assam in the east, and Madras in the south.

The outbreak areas of locust swarms where the desert locust remains and breeds permanently, lie in a vast desert tract, extending from Rajputana to the west coast of Africa (Text-Fig. 1). Investigations carried out for 8-9 years (1931-39) have shown that in India, permanent breeding grounds of this locust are in the desert

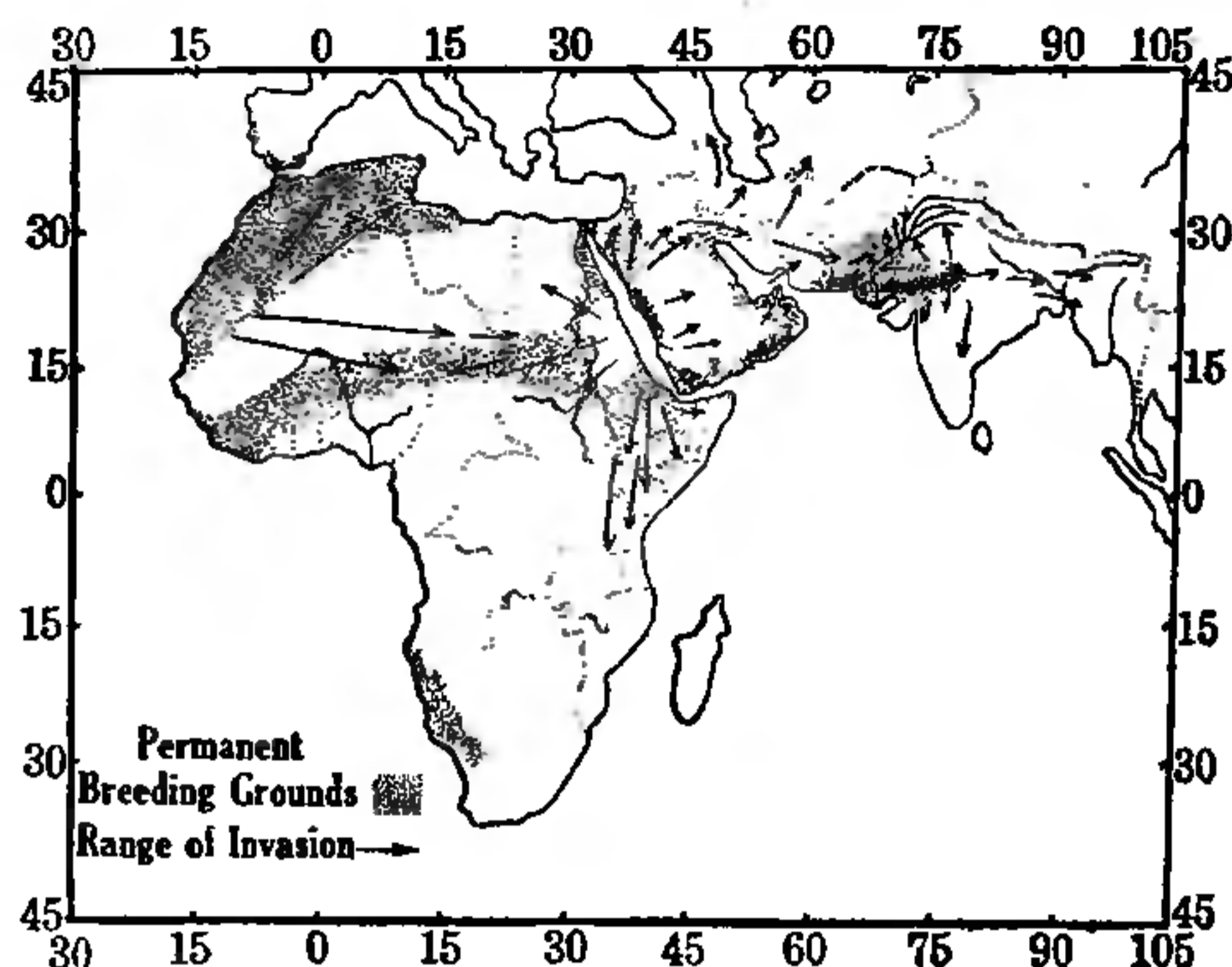


FIG. 1

Permanent breeding grounds of the Desert Locust and range of its invasion

regions of Rajputana, Sind, certain areas of Khairpur and Bhawalpur States and the coastal area of Lasbela and some parts of Kalat State in Baluchistan. These otherwise dry and desert tracts (Text-Fig. 2) become



FIG. 2

Pasni Reks, a desert area in South Baluchistan, where an important out-post of the Locust Warning Organization is situated

green with mostly wild vegetation after rainfall (Text-Fig. 3) and support locust breeding. Generally locust population is not heavy and cultivators and general public are hardly aware of it. When thus scattered about and rather inactive in movements, the locusts are said to be in the solitary phase. However, if the rainfall is abundant in the permanent breeding grounds and other meteorological conditions are favourable, the locusts multiply very rapidly, giving rise to immense swarms which fly actively, leave the desert homes and invade



FIG. 3

Pasni Reks after rains (the scrub vegetation gives cut lot of foliage)

the neighbouring parts of the country. This active phase of locusts in which they have the tendency to move in mass-flights is called the swarming or gregarious phase. The cycles of locust visitations referred to above are when the locust was in this phase.

GENERAL BIOLOGY OF THE LOCUST

The desert locust, like common grasshoppers, has three distinct stages in its life-history: (1) egg; (2) hopper, the name given to the young wingless individual, which moves about by hopping; and (3) adult or flier.

The freshly emerged fliers of swarming phase are pinkish in colour, but after a fortnight or so (during spring and summer) they become sexually mature, when they assume a distinct yellow colour. The adult locusts of the solitary phase are grey and are only slightly yellowish when mature.

The adult locusts although very active during the day usually do not fly during the night and on cloudy days. After sunset they generally settle down on crops and trees and feed on them. Most of the damage is thus done during 5 p.m. to 10 a.m.

The female lays eggs in moist soil, preferably soft, sandy or loose soil, after drilling a 3" to 6" deep hole with its abdomen. During her life-time a female has been observed to lay as many as eleven clusters containing 60 to 120 eggs each at an interval of about one week, so that the total number of eggs laid by a female may be over 800.

The eggs generally resemble rice grains. They hatch in about 2 weeks in summer and in 3 to 4 weeks in spring and autumn, depending on temperature and soil moisture.

Hoppers.—The hoppers of the solitary phase possess uniformly green colour

throughout their life which harmonises with the colour of the food plants in which they conceal themselves. They do not form bands. The hoppers of the swarming phase are almost black during the first 2 to 3 stages but later develop yellow and greenish-yellow colour with black markings. They collect together to form bands and move in columns. The two phases mentioned above are interchangeable. If the swarming phase hoppers are thinned out by control operations or other adverse conditions and live an isolated life, they assume characters of solitary phase; on the other hand if solitary phase hoppers are massed together, they develop swarming phase characters.

The hopper or wingless stage lasts from 6 to 8 weeks in spring and 4 to 5 weeks during summer.

NATURE AND EXTENT OF DAMAGE

Immense destruction is caused by fliers but more so by hoppers. There are very few plants which are not eaten by locusts. They are capable of consuming the entire vegetation of a locality, devastating crops, completely defoliating and denuding fruit and shade trees. In the case of hoppers, the activities extend still further. They invade houses, enter kitchens, store rooms, etc., and make life miserable. Sometimes they fall into wells in millions and render the water unfit for drinking purposes. At times the hoppers block railway traffic for hours by making the line slippery on account of their crushed bodies. Since they remain restricted to particular places, the intensity of damage is more severe than in the case of adults which fly off from place to place.

Temperature affects considerably the activities of hoppers as of fliers. The hoppers are sluggish during cool hours of the day. At night they rest in bushes and in the morning when it becomes warm, they begin to march in large bands. They do not ordinarily change their direction of movement, but follow their path relentlessly.

PERMANENT BREEDING AREAS IN INDIA

There are two main permanent breeding areas in India:

- (1) Desert area of Baluchistan—spring breeding area, which receives rainfall generally in winter.
- (2) Desert areas of Sind-Rajputana—summer breeding area, which receives rainfall during summer.

The overwintering locusts start breeding in the desert areas of south Baluchistan

(Mekran) after winter rainfall, as soon as the weather conditions begin to warm up in February. The adults of first generation are produced by about middle of April. If the rainfall is also received in the interior of Baluchistan or the soil conditions are suitable otherwise for oviposition, as is sometimes the case in Kulanch, Kolwa and Kachhi areas, there may be another generation in May-June. Majority of these locusts then gradually migrate eastward, to Sind-Rajputana area, where they start breeding again on account of monsoon rainfall received during summer months. There may be two generations in the area if the conditions are favourable. Population of the locusts in this region rises during September-October, after which the adults migrate back to the winter-rainfall area, i.e., Baluchistan, ready to breed during next spring.

It may be added that Arabia and Iran and other adjoining countries in the west resemble Baluchistan with regard to time of locust breeding and like the latter are sources of locusts received in Sind-Rajputana during summer.

The cycle of breeding and migration described above goes on year after year till suitable conditions, particularly rainfall, in either or both the breeding grounds help in mass multiplication and changing of the solitary into swarming phase. In the swarming phase, the distribution is unlimited and as already stated locusts reach distant provinces like Bengal and Madras.

INAUGURATION OF SWARMING PHASE IN 1940

After the last locust cycle ended in India in 1931-32, the locust was found for nine years in the desert tracts of Baluchistan, Sind and Rajputana in the solitary phase. In the summer of 1940, there was a change from solitary to the gregarious phase and the centre of development of this change was in Sind-Rajputana. A brief history of this change of phase is as follows:—

In the Persian Gulf coast of Mekran (Baluchistan), the highest population of overwintering locusts in the beginning of 1940 was about 240 per sq. mile, while very few specimens were traceable in the hinterlands. After the winter rainfall (about 2.25") received in the coastal areas and Kolwa valley in January and February, the locusts started ovipositing towards the end of February. Breeding was rather light and scattered. The hoppers emerged during the first week of March and completed their

life-cycle by the middle of April. Scattered breeding was reported up to the middle of May. The population of adults of the spring generation was low. In Kachhi area (Kalat State), the population was 2,560 per sq. mile in June. The adults of the spring generation were all of the solitary phase.

From the foregoing, it is clear that the locust population in all the permanent breeding areas in Baluchistan in the spring and early summer of 1940 was not appreciably high, and nowhere was any incipient swarming observed.

In the desert tracts of Sind and Rajputana the locust population was lower than even in the previous year up to May 1940. Immigrants from the west began to appear in this area early in June as usual. The migrant forms were of grey colour and of solitary phase. Owing to the widespread precipitation received in May and June, the soil moisture conditions all over Sind-Rajputana became suitable for oviposition. In July hoppers of I-V stages in fair numbers were observed in Thar-Mallani parts of Sind, Jaisalmer, Jodhpur and Bikaner States. A further influx in locust population presumably as a result of some more migrants from west was recorded in July and the population density shot up to 8,000 per sq. mile in Thar-Mallani area and 2,080 in Bikaner State. A somewhat remarkable feature observed in this month was that a large proportion of the locusts from some localities showed intermediate and gregarious characters. Besides this, small loose swarms of sexually mature yellow locusts (of gregarious phase) appeared in Suratgarh and Lunkaransar tehsils of the Bikaner State in the second week of July and again early in August. Some of the yellow locusts were seen in north Jaisalmer also in the end of August and first week of September and later on spread to the south and south-west in this area. Concentrated oviposition, presumably took place over a wide area in Bikaner and Jaisalmer States and in Tharparkar district of Sind and the hoppers emerging in September bore gregarious characteristics and the adults which developed from them were pink in colour and formed swarms in the beginning of October.

It is rather difficult to accurately determine the origin of the yellow locusts of gregarious phase which appeared in Bikaner State in July. Judging from the poor breeding in the previous spring in Baluchistan it is clear that these swarms did not originate from

that area. On the other hand, the conditions being extremely favourable for crowded breeding in Sind-Rajputana in early summer on account of patchy vegetation after the prevalence of drought conditions for several years, it is possible that concentrated oviposition took place in some sparsely populated areas by grey migrants or indigenous adults in the end of May, leading to the development of gregarious individuals, which on obtaining sexual maturity became yellow. If this be so, it is evident that in case the conditions are favourable, the desert tracts of Sind-Rajputana can serve as an outbreak centre independent of Baluchistan.

The other source of origin of the gregarious individuals described above may be extra Indian. The history of immigrant swarms in Rajputana-Sind during 1941 shows that this source was really very important, but due to war conditions no information was or is available from foreign countries for the first half of 1940, except for a newspaper report in May that eastern Iraq was threatened with locust invasion.

The swarms, which originated in October-November 1940, from Bikaner and Jaisalmer States in Rajputana and Tharparkar district of Sind, flew towards the west and north-west and visited southern and western districts of the Punjab and N.W.F.P., North Sind and Baluchistan. Apparently some swarms went further west into Iran, Oman (Arabia), etc. Some flew towards the east visiting some southern and central states of Rajputana, south-eastern districts of the Punjab and some western districts of United Provinces. The swarms were most active in November and their activities continued up to January 1941.

In order to discover the overwintering areas of the swarms, the staff of the Locust Warning Organization, assisted by some other research staff of the Imperial Entomologist, carried out intensive and extensive surveys from December 1940-February 1941, of the areas visited by the swarms. In all these areas locusts were traceable, the maximum locust population on the Mekran coast was 26,000 per sq. mile, in Jhalawan 10,000 and in Kachhi 77,000. In Sind-Rajputana the highest population was 21,000 at Arjansar (Bikaner State). Spring breeding (1941) was particularly heavy in Jhalawan and Kachhi areas of Baluchistan, where soil remained suitable for oviposition up to the end of May owing to favourable rainfall and

periodic flood waters received in that region. In Mekran the winter-spring precipitation was rather deficient, and therefore, there was only light breeding in most of the localities except in Dasht-Gwadar area, where owing to sufficient rainfall in February, hoppers in large numbers were observed in March and April 1941. Control operations were carried out mostly under the direction of the Locust Warning Organization in Mekran, Jhalawan and Kachhi (Kalat State) with the help of labour provided by the Baluchistan Administration. In Kachhi very heavy concentrations of overwintering locusts were traceable in the cultivated fields. Oviposition occurred in March and hoppers were observed about the middle of April. In some areas the hopper population was 78,00,000 per acre. About 50 per cent. of the IV-V stage hoppers were of gregarious phase. Several lakhs of adult locusts and millions of hoppers were destroyed by beating, baiting and burning and thereby the population was reduced considerably. In spite of the large breeding capacity of the locust, the maximum population in June 1941 was only 11,000 per sq. mile. Thus by continuous and systematic control work the population was reduced considerably and incipient swarming prevented. Therefore the chances of eastward migration of adult locusts to Rajputana were reduced to the minimum.

From the foregoing it is clear that there was no incipient swarming in Baluchistan during the last spring and early summer which is one of the important sources for the swarms for Rajputana and other parts of India. However, between the end of June and the first week of August two principal waves of immigrant swarms came from countries beyond the western borders of India. They flew over the whole of Rajputana and Western India States, touching Hissar in the east and some western districts of the Punjab in the north, but they laid eggs mostly in the Lasbela State (Baluchistan), Tharparkar district (Sind), Cutch and Tharad States (Western India), western parts of Jodhpur State and south-western parts of Jaisalmer State, etc., which received fair amount of rainfall in August-September. Active breeding was in progress in these areas during July, August and September. Oviposition took place on several occasions and by the end of August hoppers of all stages were met with. The hoppers started becoming adults from the

end of August onwards. The largest number of home-bred swarms originated from Tharparkar district of Sind, but Lasbela, Cutch, Jaisalmer and some areas in Rajputana have also contributed some swarms. The swarms, which have originated from Sind, Lasbela and Jaisalmer, have mostly flown in north and north-east direction and invaded the cultivated areas of North Sind, Khairpur and Bhawalpur States, south-eastern districts of Baluchistan and southern and south-western districts of the Punjab. The swarms originating from eastern Rajputana States also flew mostly from south-west to north-east and have visited Alwar, Hissar, Muttra and Aligarh districts in the east, and in the southern direction the swarms have flown over Bhopal and Indore in Central India and Hoshangabad, Nagpur and some other districts in the Central Provinces. So far detailed information has not been received about the areas of oviposition outside Rajputana by these home-bred swarms, but it appears that eggs have been laid in parts of Sind, Alwar State, Gwalior, Muttra and Aligarh districts of the United Provinces.

As the oviposition by the first batch of swarms took place in several series and breeding of second generation also started about the middle of September, it appears swarms will originate right up to the end of October, if not a few weeks later, unless the weather suddenly cools down. Last year the swarms continued to be active in north-west India right up to the end of December and restarted their activity in February.

LOCUST CONTROL ORGANIZATIONS

The Government of India have a permanent Locust Warning Organization which is always engaged on the study of the rise and fall in the population of the locust, even when it is in the solitary phase, in different desert areas of North-West India. The staff of this organization carefully studies the conditions under which the locust lives and changes into the gregarious phase. As soon as the organization observed the locust in the incipient swarming phase last year, it warned all the Provinces and States likely to be invaded, of the possibility of the inauguration of a fresh locust cycle. Under the advice of the Central Locust Warning Organization, Governments of various Provinces and States established the locust control organizations, mostly consisting of Revenue Officers, the superior officers of which have been trained by the Central Locust Warning Organization in anti-locust work. These regional organizations have carried out extensive control work during this year. The Central Locust Warning Organization, apart from rendering help in the field in the choice of suitable control methods, has been keeping, from its headquarters at New Delhi, all the Provinces and States, informed of swarm movements and the intensity of breeding in various areas. In view of timely warnings, crops have been saved from considerable amount of damage and the saying 'forewarned is forearmed' has proved very true in the control of this pest.

INDUSTRIAL RESEARCH FUND

THE resolution recommending "that a fund, called the Industrial Research Fund, for the purpose of fostering industrial development in this country, be constituted and that provision be made in the budget for an annual grant of Rs. 10 lakhs to the Fund for a period of five years", moved by Sir A. Ramaswami Mudaliar, was accepted by the Central Assembly at its session, on the 14th November.

Sir A. Ramaswami Mudaliar explained in detail the valuable work carried out by the Board of Scientific and Industrial Research, since its inception 18 months ago, under the able guidance of Sir S. S. Bhatnagar. The Government considered that

it was time that a separate fund be constituted for Scientific and Industrial Research, to place it on an independent and permanent footing. The Commerce Member paid a warm tribute to the work of Sir S. S. Bhatnagar and scientists all over the country, who have successfully investigated several problems of practical interest presented to them. The constitution of the Industrial Research Fund, which will be administered by a Board of Trustees consisting of some officials and prominent scientists and industrialists, will place the Board, more or less on a prominent footing and render possible the expansion of its activities.