Indian children is clear. We have no hesitation in saying that English should be the medium in the Universities and Hindi or preferably Urdu in the High Schools. To us it seems that, if reduced to this simple form, the suggestions of the Gaekwar of Baroda must before long become the declared object of the educational policy of the Indian people themselves. It is almost impossible to imagine that the rapidly growing millions of India can ever be English-speaking. But it is not too much to suppose that the British administrators can become vernacular-speaking.

We are aware that this ideal must be somewhat remote for various reasons, the chief of which is that languages are among the most cherished vested interests of the people. We hope that it may nevertheless be fulfilled soon, since it calls for no sacrifice, but only for additional achievement. We have to realise that even in the ordinary affairs of life we find it difficult to become friendly with those with whom we cannot converse in their own language, whose habits and manners we have no means of understanding and whose literature we cannot read. The removal of such barriers must produce an atmosphere fostering friendship and peace, and will dissipate the misunderstanding and unhappy relations engendered by ignorance. We urge that in a case where the interests of a vast Empire are involved no effort which tends to consolidate the Government and people into an organic unit should be considered too great or beyond the resources of wise and far-seeing statesmanship.

Flow Beneath Masonry Works Founded on Sands.

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A COMMON characteristic of the Head-works of a number of canal systems in the Punjab and elsewhere in India is the construction of a weir across the river and a system of gates regulating the supply to the canal. The weirs that have been constructed usually rest on the sand beds of rivers and their stability largely depends on the flow of water under the weir and the pressure on the work due to the head of the water above the weir. Studies of the conditions of flow under the weir and of the pressures involved are therefore of the greatest importance both in connection with the design and stability of the work. A series of investigations on the above subjects has been in progress at the Irrigation Research Institute, Punjab, during the past year and although these are not by any means complete, the results are of interest as they indicate that theories of design which have been previously accepted are incorrect and that problems that were not suspected in the past require solution. A brief account of the work that has been done and the results obtained will be given.

The first step in these investigations was to devise a method of tracing the flow under a model of a work. After a number of trials the following was the method adopted. A tank was constructed of the following dimensions: 3′ 10″ × 2′ 6″ × 2″. The tank was partially filled with a graded sand and the model placed in position on the sand. A solution of potassium chromate was then placed in the tank and after a certain period, usually six hours, the sand had become completely saturated with this solution. Upstream of the work a series of tap funnels was placed in position from which it was desired to trace the flow. The tap funnels contained solutions of silver nitrate which on entering the sand reacted with the potassium chromate along the lines of flow and so traced the lines of flow from the series of points.

The steel back of the tank carried a large number of pressure points which were inserted in the sand. The pressure points communicated with a series of manometer tubes and so the pressures under the work could be determined at the same time as the streamlines were being traced. The series of models investigated commenced with the simple forms of impervious floor and a sheet pile. Later more complicated combinations of these structures were investigated.

Fig. 1 shows the streamlines traced under a model of an impervious floor protected by upstream and downstream aprons and upstream and downstream sheet piles.

In the space available it is not possible to give the data on which the conclusions have been based nor is it possible to discuss fully the differences between formerly accepted views and the conclusions to be drawn from these investigations.

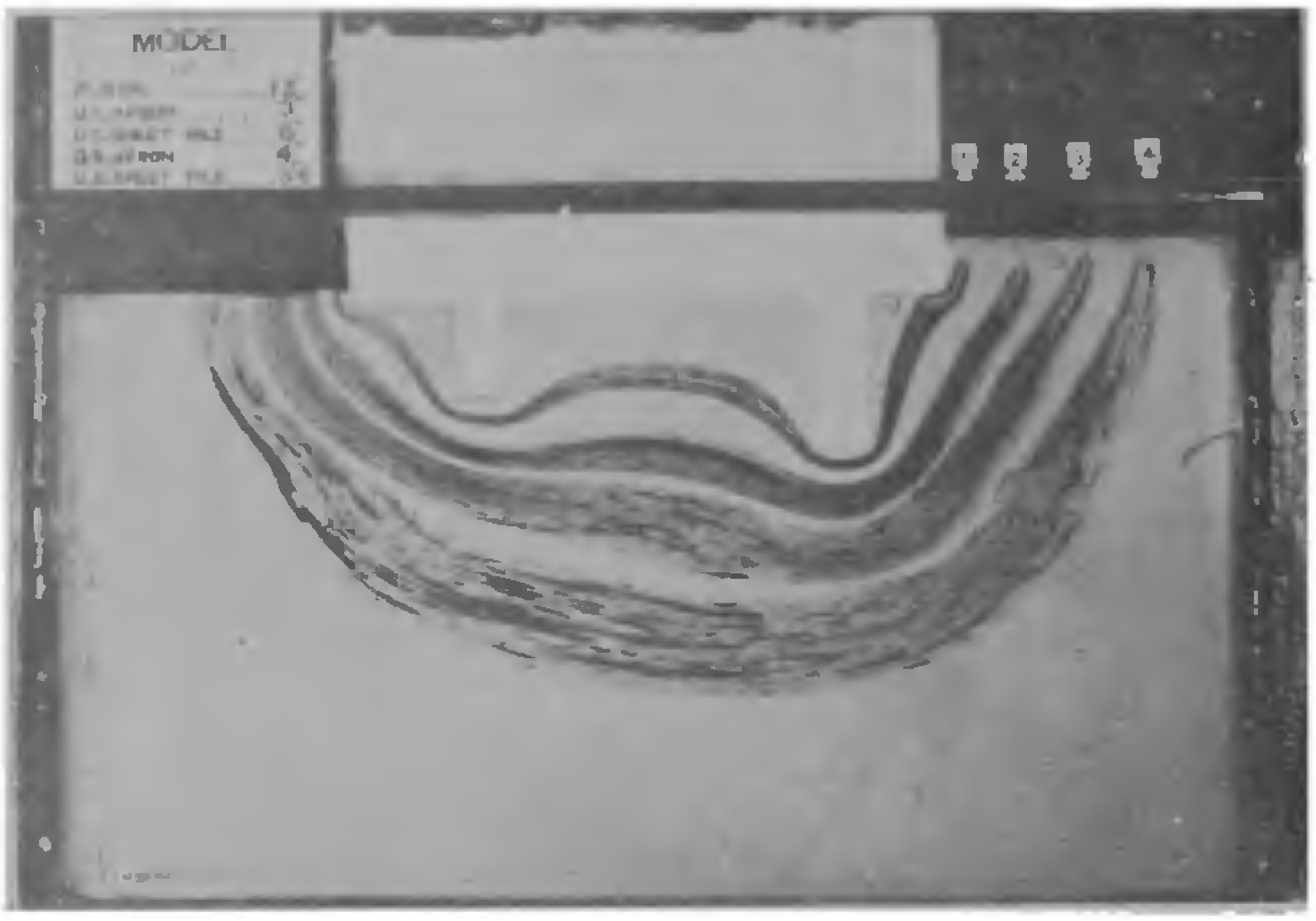

Fig. 1.

Until these investigations had been undertaken, very little data was available upon which theories of flow under a weir could be based. In fact, the accepted views were more in the nature of hypotheses than theories. The main hypothesis that had been accepted by Engineers was that of Bligh which can be stated as follows:—

"The main determining factor in the stability of the sand is the length of percolation or so-called 'Creep'. If an impervious line of sheet piles be inserted below the floor the line of creep may be measured down one side of the vertical obstruction and up the other side. The added length of creep will then be twice the length of the piling."

A further hypothesis regarding the flow is that due to Forchheimer. From a theoretical treatment of this subject he deduces that the flow under a floor should be in the form of a series of semi-ellipses symmetrical with reference to the floor. Since the streamlines cut the equi-pressure lines orthogonally, it follows from this that the pressure distribution should also be symmetrical with reference to the model. The results of the present investigation have shown that the creep which was imagined to take place by Bligh is not existent. Instead of the flow following the profile of the work it follows a series of curves determined firstly by the profile and secondly by the nature of the material, such as clay bands which may underlie the work at some distance from the surface. In any model composed of a floor and a system of sheet piles there appear to be two divisions occurring in the flow nearest the work. The first of these divisions is the major line of flow, the second is the diffused flow of very low velocity situated between the line of major flow and the work. One of the main effects of a system of sheet piles is to break up the flow into these two portions so that the velocity of flow near the work is very low and, hence, the work becomes stable from this point of view. The most stable form of work appears to be that illustrated in Fig. 1. The least stable form so far investigated appears to be an impervious floor protected by an upstream sheet pile. In this latter case there was a concentration of flow at the downstream end of the work which leads to instability owing to the velocity of the exit of the water being sufficiently high to cause the blowing of sand.

Possibly of greater importance than the actual flow of water under the work are the pressures under the floor. So far the investigation of the pressures has been mainly confined to those existing on a simple impervious floor. The results have raised a number of points not previously suspected and until the mathematical analysis of the results has enabled a theory to be put forward which covers the flow under these simple conditions it seems useless to investigate more complicated forms.

Up to the present time the examination of the pressure observations under a simple floor have led to the following conclusions :–

(1) The flow under a simple impervious floor is a series of semi-ellipses.

(2) The ellipses are not symmetrical with reference to the geometrical centre of the model. This fact invalidates the theoretical treatment of Forchheimer.

(3) The equi-pressure lines are not symmetrically distributed with reference to the geometrical centre of the model. They appear to be symmetrical with reference to the equi-pressure lines representing approximately 44 per cent. loss in head. This is again not in accordance with Forchheimer's deductions. Fig. 2 shows the type of pressure distribution observed.

(4) There appears to be a relatively large loss in pressure when the water enters the sand upstream of the model.

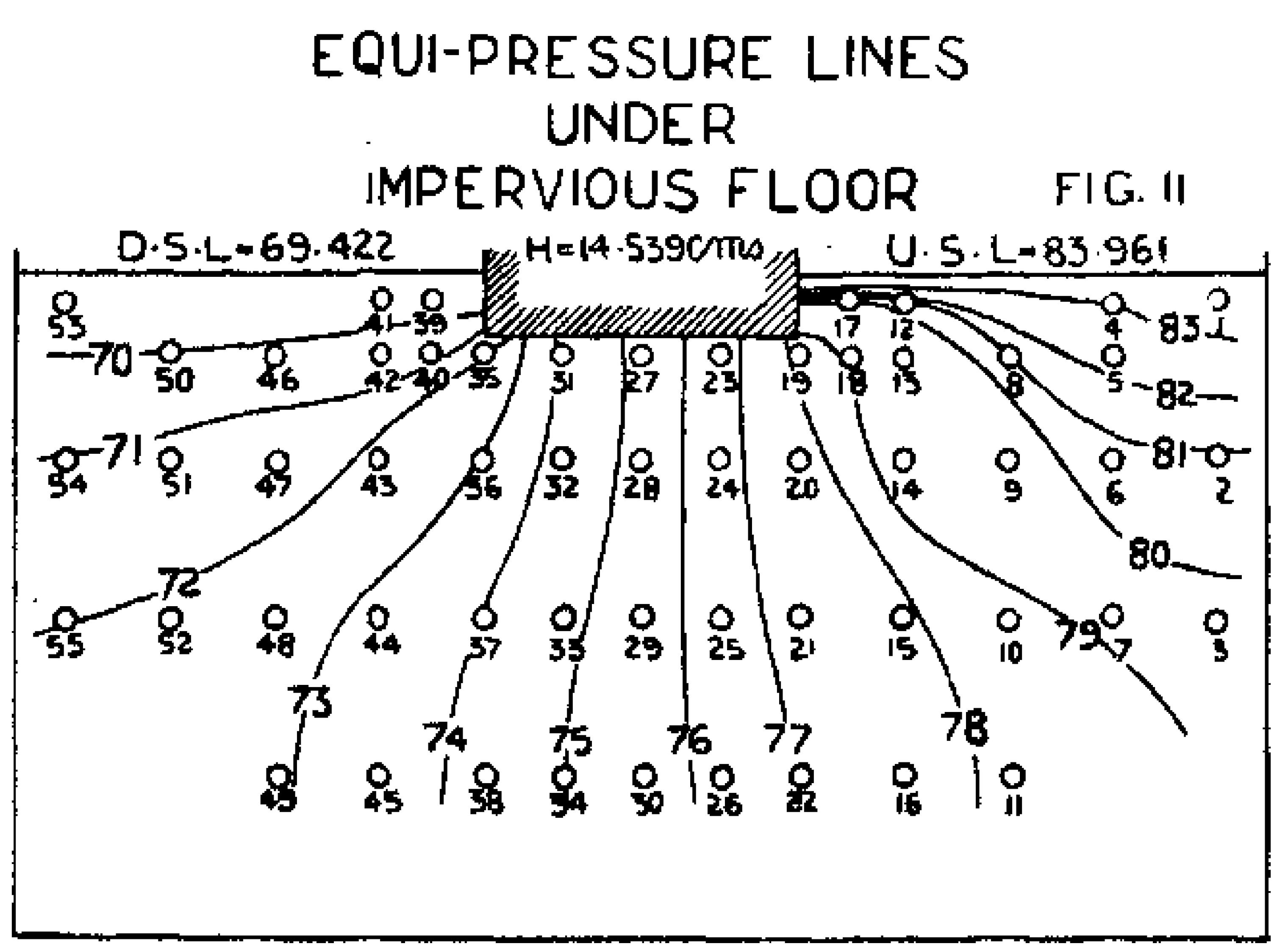

Fig. 2.

It is impossible at this stage to give a complete mathematical treatment of these results. Further experiments are now in progress with the object of studying intensively the pressure variations at critical points under the model. Until these results are available the conclusions already set forth cannot be amplified.

Although this work has only been in progress for about six months it has already found applications to engineering works. The first work to be studied was in connection with the repairs and reconstruction of Khanki Weir, the Head-works of the Lower Chenab Canal, Punjab. The first repair undertaken was the driving of sheet piles at the upstream end of the impervious floor in certain bays. From a study of a model of this construction it was forecast that the bays which had been so treated were in a less stable condition than they were originally before the repairs had been effected. Such proved to be the case, as portions of the floors of Bays Nos. 3 and 4 were damaged during the Kharif Season of 1933 shortly after the forecast had been made. During the cold weather of 1933-34, further reconstruction of the weir was undertaken and at the request of the Chief Engineer models were examined to determine the effects of the proposed measures.

It was shown that the proposals would result in a low velocity of flow in contact with the work but that owing to the presence of cavities under the upstream portions of the work the Hydraulic Gradient would be very steep in this region. The upstream portion of the work would, therefore, tend to be unstable.

In this connection the effect of the pressure relief pipes through the floor, which are a common feature of some works was also investigated. The pressure relief pipe normally installed just passes through the floor. It was shown that pressure relief pipes of this type resulted in the removal of sand from under the work resulting in the formation of the cavities which endangered the stability of the floor and was particularly dangerous because the damage was not open to inspection. In continuation of this investigation the effect of a tube-well, the strainer portion of which was situated some considerable distance beneath the floor, was examined. It was shown that the tube-well effectively relieved the pressure without endangering the stability of the sand. Tube-wells are now being installed in the floor of Khanki Weir where damage may occur through the presence of springs.

In the foregoing account an attempt has been made to indicate the nature of the new developments which are taking place in the

study of one aspect of hydraulics as applied to engineering works. The study at present is very incomplete but its importance is shown by the fact that the results have already found practical application at this early stage of the investigations.

The Occurrence of Crossing over in *Nicotiana* Species Hybrids.

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NUMEROUS trigenomal species hybrids were produced by crossing the F_1-hybrids with a third species or with the parental forms. They offer a very rich cytogenetic material which will be here considered in connection with the exchange of parts between the chromatids of the presumably homologous chromosomes of the species crossed.

The first meiotic division in *Nicotiana* is the reductional division. The univalent chromosomes in the hybrids and in the haploids are distributed at random to the two poles during the first meiotic division and divide during the second one. Exceptions, *i.e.*, division of univalent chromosomes during the first meiosis, occur so rarely that they can be neglected. We have observed such only in the haploid *N. Langsdorffii* (one chromosome has divided in 0·1% of the pollen mother cells) and in the hybrid *N. tabacum* ($n=24$) × *N. glauca* ($n=12$), in the latter, the dividing chromosomes being less frequent (Kostoff 1929, 1930).

In a great many *Nicotiana* species hybrids gametes are formed with the somatic number of chromosomes (unreduced) originating from restitution nuclei (Rosenberg's term). Some of the lagging chromosomes on the spindle in the hybrids do not succeed in reaching the poles during the I meiosis and form a bridge between the two poles, so that all chromosomes (somatic number) undergo interkinesis altogether forming one restitution nucleus. Second divisions with only one metaphase having the Somatic chromosome number of the plant have been often observed in the hybrids where restitution nuclei are formed at the end of the first division. The number of such metaphases is approximately as high as the number of the dyads formed. The number of the large pollen grains formed is about two times greater than the number of the dyads observed. Formation of equal dyads following fusion of both spindles during the second division has been very rarely observed. (This abnormality in meiosis leads to the same result as the formation of restitution nuclei.) Therefore the unreduced gametes formed during the meiosis in *Nicotiana* species hybrids usually result following non-occurrence of the reduction division.

The hybrid *N. glauca* ($n=12$) × *N. Langsdorffii* ($n=g$) represents one of the best examples in this respect. In this hybrid numerous unreduced gametes are formed following non-occurrence of the reduction division. The chromosomes of *N. Langsdorffii* conjugate with 9 chromosomes of *N. glauca* so that 12 chromosomes (9^2+3^1) have been usually observed during the first metaphase. The bivalent chromosomes disjoin during the I anaphase but the separation is often very much retarded so that restitution nuclei are formed, the chromosomes undergoing interkinesis in one group. Following such an interkinesis all chromosomes (12–*glauca*+9–*Langsdorffii*=21) appear in one group of 21 during the second division, *i.e.*, second metaphase with one spindle and one metaphasal plate with 21 chromosomes is formed. Then the equational division follows, so that dyads (instead of tetrads) are formed, each one having 9–*Langsdorffii* chromosomes and 12–*glauca* chromosomes or altogether 21 chromosomes. These chromosomes have been formed as chromatids during the prophasal stage of the I meiotic division. If there was no exchange of segments (parts) between the conjugating *glauca* and *Langsdorffii* chromosomes during the meiosis, the unreduced gametes thus formed should be identical, *i.e.*, they should have the same genetical constitution. If there was an exchange (or exchanges) of parts of *glauca* and *Langsdorffii* chromosomes, the unreduced gametes formed should not be genetically identical. They should differ one from the other by a series of genes. Finally, if there was an exchange (or exchanges) of parts between the chromosomes (but not between the chromatids) of the parental species the unreduced gametes of one dyad should be identical, but the