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A STUDY ON INVENTORY MANAGEMENT CONTROL TECHNIQUES IN AUTOMOBILE SECTORS: FSN & VED ANALYSIS

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ABSTRACT
Inventory management & control is the process of efficiently overseeing the constant flow of unit's an existing inventory. Spare part management plays an important role for desired commodities availability at an optimum cost. Inventory management is necessary for maintaining the spare parts in every production unit and retail sectors. Inventory control is the most important for production in the cost of product. Material is like cash in cost accounts and hence it need to be controlled. Systematic stock control over the storage & utilization of material, stock is referred to as stock control. Another angle having many spare parts will mean extra cost time & resources that company has to supply. This paper presents a spate part classification methods based on item movement in store department and criticality. FSN analysis and VED analysis, Both the analysis to find out fast moving, slow moving, non moving and VED analysis to find out vital, essential and desirable.

Keyword: Inventory control & management, criticality and models FSN analysis and VED analysis.

1-INTRODUCTION

Inventory management is a function responsible for co-ordination of planning, sourcing, purchasing, moving, storing and controlling materials / stocks in an optimum so as to provide pre-determined services to the customer at a minimum cost the important advantages of inventory management are better accountability, better performance, better growth & adaptability to electronic data processing. Material cost to be effective involves the co-operation of variables departments namely, purchasing department, receiving and inspection department, store departments, producing and stock department inventory control are managed by one integrated system. The manufacturing units and retail units, inventory control also protects the production and selling of materials lastly very simple words inventory control is a systmatic control over the purchasing, storing and using of materials so as to have the minimum possible cost of materials. The important features of inventory control system included.

(i) The quantity and specification of materials should be exact with the requirement of the product.

(ii) The price given to suppliers should be reasonable and the goods should be delivered in time.

(iii) Wastage, pilferage and cusses should be avoided at every stage of production.

(iv) Materials should be classified and properly codified to enable the smooth flow of production.

1.1-SPARE PART MANAGEMENT SYSTEMS

This system is depending on material and stock of finished products .Materials is the basic ingredient in every product. It constitutes a prime part of the total cost of production. In some manufacturing concern like textile, sugar, etc. Material constitutes 60 to 65% of the total cost. Therefore in order to reduce cost per unit proper control over purchase, storing and use of material must be exercised.

The designing of spare part inventory management system is very important for automobile sectors. It is aimed to find optional demand for a given spare parts management system i.e. how to determine optional inventory level in order to reduce cost.

Material required maintaining plant machinery equipments are known as spare parts. Then nuts, bolts and other mirror parts are some of the examples of spare parts.

An important role of inventory control can be satisfied by having the product ready and available when the customer wants it.

2.1-VED ANALYSIS

This method of control is suitable for spare parts in this system all spare parts are grouped in to three categories as:

'V'- For vital spare parts. There are critical parts, the stock-out of which will stop production immediately.

'E'- For essential spare parts. Their absence can be tolerated for few hours or even for a day. It means in their absence production can continue for few hour.

'D' – For desirable spare parts. The absence of these parts even for a week cannot stop productions.

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The prime aim of this control system is to trace the vital spare parts and store them to meet the sudden production stoppage. The criticality of the parts is more important than their money value. Similarly the material whose procurement is difficult is treated as critical & thus sufficient safety stock level should be maintained for those materials.

VED

VED (i.e.- Vital Essential and Desirable) analysis is used primarily for control of spare parts. The spare parts can be divided into their categories- Vital, essential or desirable keeping in view the criticality to production. The spares, the stock out of which even for a short time will stop production for quite some time and where the cost of stock out is very high are known as vital spares. The spare, the absence of which cannot be tolerated for more than a few hours or a day and the cost of lost production is high.

2.1.1-FSN ANALYSIS

Under this method stores are divided into four categories on the basic of their velocity of use these are

'F'- Fast moving materials which are consumed frequently.

'N'- Normal moving materials which are consumed during are year.

'S'- Slow moving materials which are used rarely- once on two to three years.

The purpose of this analysis is to

(i) Monitor fast moving materials to avoid their stock-out.

(ii) Place order for normal and slow moving materials carefully to avoid over stocking.

Whether they could be used or be disposed off. The fast and slow-moving classifications help in arrangement of stock in stores and their distribution and handling methods.

3-CRITICALITY DEFINITION AND MODELS

The classification model and criteria have been used in the after sales environment. In general, spare parts classification models can be seen to consist of one to two main components. First, the criteria and the number of different criteria need to be decided. Once those have been chosen, different groups need to be created based on the criteria. The spare part classification model suggested in this criticality is based on inventory control & management studies.. For the control criticality, three sub- categories were suggested such as failure predictability, number of suppliers, and delivery time.

Criticality Groups	Definition
1- On Demand Parts	❖ The component failure does not cause notable problems to the machine the system ❖ Problems can be withstood for more than Week ❖ Order on demand from the supplier
2- Central Stock Parts / Maintenance Agreement Parts	❖ Component failure caused noticeable problems and can be withstood for a short period of time ❖ Recommendation to keep spare parts in the central stock or having maintenance agreement with the supplier
3- Onboard parts	❖ Vital for the system and the failure needs to be corrected immediately ❖ Port authority dictates the repair to be done before the operations can be continued ❖ Recommendation to keep spare parts Onboard

Spare parts classification based on operational need provide a good foundation for further co-operation between the customer and retailers in terms of deciding who will stock what and where. For being able to develop guidelines for spare part inventory. The classification model considered in this study allows more detailed spare part recommendations and enough information to deciede the risk level they want to take.

3.1- Huiskonen et al. [1] divided criticality into process – and control criticalities. Kennedy, Patterson and Fredendall [2] have purposed of WIP inventory is to stabilize the fluctuation in production flow rate and the purpose of finished goods inventory is to balance the irregular customer demand. But, spare parts inventory assists the maintenance division for keeping the equipment in running condition. Unlike WIP inventory and finished goods inventory, spare parts are not intermediate or final products. Major difference between spare

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parts inventory and other manufacturing inventory is that spare part inventory level largely depends on the equipment use pattern and level of maintenance.

Willemain, Smart and Schwarz [3] have proposed the demand time of spare parts is usually unknown and irregular when corrective replacement method is used. The uncertainty and irregularity in demand pattern of spare parts make them slow moving items. Moreover, the intermittent demand makes the forecasting of spare parts difficult.

Vaughan et al. [4] has proposed even in the case of planned or preventive maintenance, the spare parts demand is irregular since defective but working parts may be identified during preventive maintenance.

Celebi, Bayraktar and Aykac [5] have proposed the unpredictable – demand, limited access and down time impact are the major constraints of management of spare parts. For efficient management of maintenance task, proper spare parts inventory management is important.

Diallo, Ait-kadi and Chelbi [6] have purposed the spare parts, they are purchased from the original manufacturer or their authorized representative. The limited access of spare parts increases lead time and encourages bulk purchase. An organization should rely on the manufacturer recommended maintenance and spare parts replacement schedule for the purchase volume.

Driessen, Arts Houtum, Rustendberg and Huisman [7] have purposed that sometimes lower inventory level of spare parts may lead to stock out and increased downtime which is a loss of production.

Kampem et al [8] has broadly categorized the inventory classification techniques into different categories based on the inventory modeling methods / approached.

Baets and Pintelon [9] developed a multi-criteria classification method based on spare parts criticality. The different parameters influencing spare parts criticality are equipment criticality, probability of failure of the item, replenishment time, number of potential supplier, availability of technical specifications and maintenance type. Based on these on these characteristics, spare parts are classified into three classes representing different levels of criticality (high, medium, low). The multi-criteria classification method is based on the AHP and the logic of decision diagrams. By combining these two techniques, numerous potential attribute influencing spare parts criticality are taken into account in an easy and rational manner.

Zeng, Y.R., Wnag, L. & He, J. [10] have proposed there is not a consensus which classification model and criteria would be the most suitable one to be used in the after sales environment. In fact, it is said that research literature does not even know the existence of a systematic and well-built criticality assessment process.

Vaisakh et al. [11] have proposed the combined use of FSN (Fast, Slow and Non Moving items) and VED analysis to classify inventory based on their consumption pattern and criticality. The inventory item included raw materials, spare parts and work in process inventory in stores of a chemical process industry. The authors indicate that this hybrid technique could substantially reduce the space and the inventory holding costs.

Lolli et al. [12] have broadly categorized the inventory classification techniques into different categories based on the inventory modeling methods / approached.

3.1.1 Figure & Table

According to this analysis the items are classified into

(1) Fast Moving (F)

(2) Slow Moving (S)

(3) Non Moving (N)

Fast moving goods are good indication for profitability. Slow moving (S) and Non-Moving (N) on the basis of their rate of consumption. The measures for slow moving goods are to the analyzed & steps should be taken to dispose them at the earliest. Non Moving goods increate the materials handling cost.

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Table -1: Opening Balance: 50

Date	Receipts Quantity	Returns Quantity	Adjustment Quantity	Issue Quantity	Closing Balance	Inventory Holding days
1/1/97	15	0	0	0	60	60
2/1/97	10	7	0	15	67	127
3/1/97	0	0	0	0	67	194
4/1/97	0	0	0	0	67	261
5/1/97	0	0	5 (+)	0	72	333
6/1/97	20	0	0	0	92	425
7/1/97	0	0	0	12	80	505
8/1/97	0	4	0	0	84	589
9/1/97	0	0	0	0	84	673
10/1/97	10	0	0	7	87	760
11/1/97	0	0	0	0	87	847
12/1/97	0	0	0	12	75	922
13/1/97	0	0	0	0	75	997
14/1/97	10	0	3(-)	0	82	1079
15/1/97	0	0	0	0	82	1161
Total	65	11	2(+)	46	-	-

Average of the material = $$\frac{\text{Cumulative No of Inventory Holding Days}}{\text{(Total quantity received+Opening Balance)}} = \frac{1161}{115} = 10.09\ Days$$

Consumption Rate= $$\frac{Total\ Issue\ Quanity}{\text{Total Period Duraiton}} = \frac{46}{15} = 3.06\ Nos\ /Days$$

Now list down the materials with average stay of the material =

$$\frac{\text{Cumulative No of Inventory Holding Days}}{\text{(Total quantity recieived + Opening Balance)}} = \frac{1161}{115} = 10.09\ Days$$

Table - 2

Item Code	Average Stay	Consumption Rate
1	10.09	3.06
2	7.5	5.2
3	8.23	4.71
4	4.2	2
5	6	5.1
6	12	5.76
7	8	3.98
8	9.11	4.48
9	11.12	5.23
10	7.31	4

Carry out the FSN analysis on the basis of Average Stay as below by sorting down in descending order of Average stay. Every company has its policy for defining FSN. Here FSN has been taken as F-10%, S-20% & N-70%.

Table-3

Item Code	Average Stay	Cum. Average Stay	% Average Stay	FSN Classification
6	12	12	14.36	N
9	11.2	23.2	27.77	N
1	10.09	33.29	39.85	N
8	9.11	42.4	50.75	N
3	8.23	50.63	60.61	N
2	7.5	66.13	79.16	S
10	7.21	73.34	87.79	S
5	6	79.34	94.97	F
4	4.2	83.54	100	F

FSN classification only on the basis of consumption rate.

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Table -4

Item Code	Consumption Rate	Cum. Consumption Rate	% Consumption Rate	FSN Classification
6	5.76	5.76	13.24	F
9	5.23	10.99	25.25	F
2	5.2	16.19	37.2	F
5	5.1	21.29	48.92	F
3	4.71	26	59.74	F
8	4.48	30.48	70	F
10	4	34.48	79.23	S
7	3.98	38.46	88.37	S
1	3.06	41.52	95.4	N
4	2	43.52	100	N

Now carry our final classification by combining both as under.

Table-5

FSN (Consumption Rate)	FSN (Average Stay)	Final FSN Classification
F	F	F
F	S	F
F	N	S
S	F	S
S	S	S
S	N	N
N	F	S
N	S	N
N	N	N

FSN Analysis, Identification of fast moving, slow moving and no moving inventory, Inventory Control using FSN analysis, Inventory Analysis.

3.1.2. VED Analysis

Organizations mainly use this technique for controlling spare parts of inventory. VED-Vital, Essential and Desirable analysis is used primarily for control of spare parts. The spare parts can be divided into three categories- Vital, Essential, Desirable keeping on view the criticality to production.

VED ANALYSIS

Vital-(V) Used maximum 4 times

Essential-(E) Used minimum 2 to maximum 3 times

Desirable- (D) Used once

V- There are 6 times in the list. Here ed.no like 5353 and 5301 have been in use regularly. So it is beter to follow the existing model for them. But for the items with around 4 units of consumption, only 1 hob can be present in the main store.

E- There are 6 items in the list. They are moderately used items thus are not very critical. Therefore 1 unit quantity in the main stores and 2 units at setting may be enough.

D- There are 14 items in the list. These are rarely used items. Single units of these in both tool crib main store would be enough.

VITAL

Table-6

S No	ED NO	PRODUCTS	ISSUES
1	5353		3
2	7007		4
3	5319	13	3
4	5335	28	3
5	7013	20	3
6	5301	16	3

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ESSENTIAL

Table-7

S No	ED NO	PRODUCTS	ISSUES
1	2003	31	2
2	7027	42	2
3	5334	78	2
4	7026		2
5	5316		2
6	2015	33	2

DESIRABLE

Table-8

S No	ED NO	PRODUCTS	ISSUES
1	5302	62	1
2	7716	78	1
3	2006	26	1
4	2004	26	1
5	5354	78	1
6	5351	42	1
7	2009		1
8	5326	21	1
9	2017	53	1
10	2014	27	1
11	2016	51	1
12	5301	14	1
13	7004	78	1
14	5112	20	1

4-CONCULSION

It has been conclude that in this paper aims to keep optimal inventory level of an automobile sectors with the Analysis of FSN &VED from table-1 to table-8.The proposed model gave more significant results of average of the material, consumption rate and average stay of the materials . Carry out of FSN analysis on the basis of average stay as below sorting down in descending order average stay, the results of FSN analysis identification of fast, slow,& non moving inventory, Mainly use the VED analysis techniques for controlling spare parts inventory management and have mentioned from table-6 to table-8.The analysis of VED and gave the results of vital is 4 units consumption and 1 item has been present main store. Then essential 6 items list shows in table no-7, 1 units quantity in main store and 2 setting may be enough. The desirable 14 items in table no-8 the list these are rarely used items of the above models of spare part inventory. Lastly conclude that the result of inventory control is the life blood of the automobile retail sectors.

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NEW FOSSIL DICOTYLEDONOUS SEED *Singhpurospermum deccanii* gen et, sp. nov. FROM THE DECCAN INTERTRAPPEAN BEDS OF SINGHPUR

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ABSTRACT
*A fossilized Dicotyledonous Seed is reported from the Hills of Singhpur, Madhya Pradesh, India. Small ovoid unitegmic seed is measuring **3.8 mm × 2 mm in size**. Seed cavity oval in shape and shows broad seed coat which measures **90 µm** in thickness differentiated into outer single layered epidermis, middle, and inner layer, embryo well preserved with two cotyledons measuring **1.2 mm** length & **0.2mm** breadth in size. Endospermic tissues are seen. This fossil seed is found at very famous locality of Madhya Pradesh, Singhapur. So it named as **Singhpurospermum deccanii** et sp. nov.*

Keywords: Deccan, Intertrappean, Dicotyledonous Seed,

INTRODUCTION
The present investigation deals with a study of fossil dicotyledonous seed from the Deccan Intertrappean Beds of Singhpur, Madhya Pradesh, India. So far few seeds have been reported from the different fossliferous localities of Deccan Intertrappean beds of India. They are ***Clusiocarpus arillatus*** (Kumar, 1984), ***Clusiocarpus indicum*** (Wazalwar 1990), ***Unonaspermum corneri*** (Bonde, 1993) from Nawargaon, ***Deccanosperma allirata, Ramakonospermus chitaleynsis, Mahabalespermum minutum*** (Juneja, 1993) from Ramakona locality, ***Ramakonospermus singhpurii*** (Bhowal, 2003).In addition to these seeds monocotyledonous **phoenicoid seed** is reported from Pisdura, Maharashtra by Ambawani and Dutta (2005). So the present report of new dicot seed from Singhpur is noteworthy contribution to the knowledge of fossil seeds.

MATERIAL & METHOD
The present seed was exposed on fossil chert in longitudinal view. Serial peel sections were taken without grinding the material. Peels were mounted in Canada balsam and studied. Camera Lucida sketches were drawn for its detailed study.

DESCRIPTION
The seed shows unitegmic seed coat and large embryo (Plate I. Figs. 1, 2, 3; Text Figs.1, 2, 4). It is ovoid in shape measuring **3.8 mm** in length and **2 mm** in breadth showing stalk like structure at the base with a slit which might be representing micropyle. The seed coat is unitegmic having outer integument only. The embryo is very large and occupies the maximum space of the seed cavity (Plate I. Figs. 1, 2; Text Figs.1, 2). The seed coat is well preserved but not differentiated into testa & tegmen, tegmen is ill preserved consisting of testa only. It is broad at the upper region (Plate I. Figs. 1, 2, 3, 4; Text Figs.3). Testa is differentiated into two distinct zones (Plate I, Fig.4; Text Figs.3).

Outer zone -This is **20 µm** in width**,** outermost limiting layer made up of thin walled epidermal cells. **Inner Zone -**This inner zone is made up of 4 - 5 celled regions. The cells are thick walled, penta & hexagonal in shape. The width varies from **60 µm to 62.85 µm.** The lower part of the inner zone consist of a 2 to 4 cells, which also very well arranged, the width of the region varies between **5 to 7 µm**. These cells at some places appear crushed; there is no differentiated tegmen. The embryo is well differentiated into three parts, two cotyledons, long hypocotylar region and narrow radical (Plate I Figs.1, 2; Text Fig.4). Embryo occupies the maximum space of seed cavity. In between wall of the seed and embryo there is a space around, in this region some thin walled cells are seen. The two cotyledons are present in the seed. The cotyledons are flat and measures ***1.2 mm** length & **0.2 mm** breadth.* As compared to cotyledons and hypocotyl, the radical is narrow. Suspensor is not seen. Surrounding the embryo there are thin walled parenchymatous cells which represents the tissue of endosperm.

DISCUSSION & COMPARISON
On the basis of above description seed has certain peculiar characters, which are considered for the identification of seed like seed is small in size, ovoid in shape measures about **3.8 mm × 2 mm.** Seed coat unitegmic showing presence of testa only. Testa shows outer epidermis, middle zone made up of 4 - 5 celled regions. The lower part of middle zone shows well arranged elongated, cells, some are crushed, Split seen in the seed coat region forming micropyle. Endosperm is preserved. Embryo is well preserved, it has two cotyledons. Suspensor is not present.

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All these characters are of great help in the identification of seeds and find its affinities with seeds of living families.

According to Eams (1961) there is a greater reduction of suspensor in angiospermic embryo. In the present fossil seed also, suspensor is completely absent.The most important characters helpful in the identification of seed are unitegmic seed coat. Testa is differentiated into unspecialized squarish parenchymatous epidermal layer; middle layer of the testa is also not specialized made up of pent-hexagonal cells.

The studied fossil exhibits certain characters of exotestal seed like the testa have no mechanical tissue as their inner tissues are generally crushed by endosperm or embryo (Corner, 1976).The fossil seed shows embryo with two cotyledons, hypocotylar region, narrow radical and absence of suspensor. These characters confirm that the seed under investigation is an angiospermic and dicotyledonous in nature which is derived from anatropous ovule. Seed is exarllate. Embryo is large with little endosperm.

After going through the available literature, the standard books of taxonomy and embryology by Rendle (1956); Maheshwary (1950); Hutchinson (1959); Eams (1961); Fahn (1974) were used, and most useful among all by Corner (1976), was of great help in resolving the problem of systematic position of the seed.

Corner (1976) has mentioned 105 families having unitegmic seeds, we have considered some families showing unitegmic seeds with anatropous ovule like *Apocynaceae, Alangiaceae, Bignoniaceae, Boraginaceae, Companulaceae, Compositeae, Loganiaceae, Martyniaceae, Pedaliaceae, Pittosporaceae, Sapotaceae, Solanaceae, Verbenaceae, and Convolvulaceae etc.*

Out of these fossil seed shares most of the characters of Pedaliaceae, Martyniaceae, and convolvulaceae. In Pedaliaceae, ovules are anatropous, seeds are unitegmic, seed exotestal, exarllate, testa shows presence of palisade, endosperm cellular and embryo is straight. But,they are quite different from the present seed in minute details like outer integument in seeds of Pedaliaceae is of thick walled lignified cells which are thin walled and parenchymatous in fossil seed. The seeds of Martyniaceae, also have anatropous ovule, unitegmic seed coat, exarllate seed, endosperm cellular and embryo straight like in fossil seed. But in family Martyniaceae testa is reduced to a sub gelatinous pellicle of large thin walled or sclerotic cells which are not seen (Corner, 1976) in fossil seed. Thus fossil seed differs from the seeds of Martyniaceae. The fossil seed resembles the family Convolvulaceae (Corner, 1976) which is widely distributed in tropical and subtropical regions (Hutchinson, 1959, Rendle, 1938) in bearing anatropous ovule with unitegmic seed coat, exarillate seed but the seeds of Convolvulaceae show mesophyll tissue the seed coat and hence it does not correlate with this family.

From the above it is clear that fossil seed does not show close resemblance with any family but it shows some resemblances with seeds of family **Martyniaceae** with minute differences.

The fossil seed under investigation is also compared with earlier reported fossil seeds. The previously reported seed ***Clusiocarpus arillatus*** (Kumar, 1984) and ***Clusicioarpus indicum*** (wazalwar, 1990) differs in having aril. When compared with ***Ramkonospemum chitaleyensis*** (Juneje, 1993) present fossil shows dissimilarities in not having bitegmic seed, embryo in former is curved and convolute which is straight in present specimen. ***Deccanosperma arillata*** (Juneja, 1993) differs in having arillate and bitegmic seed. ***Mahabalespermum minutum*** (Juneja, 1993), ***Ramakonospermum singhpurii*** (Bhowal, 2003) differs from present seed in possessing bitegmic seed.In ***Unonaspermum corneri*** (Bonde, 1993) is also different from present seed in possessing bitegmic ellipsoidal seed with ruminate seed coat .Ambwani and Debi Dutta (2006) have reported ***Phonecoid seed*** from dinosaurian coprolite at Pisdura in Chandrapur district. It cannot be compared with present seed, as it is monocotyledonous.

Thus it is the record of unitegmic seed from the Deccan Intertrappean beds of Singhpur. As it is different from all other seeds previously reported seeds and also do not show resemblance with the seeds of any species of living families, hence named as ***Singhpurospermum deccanii*** gen et, sp.nov.

Holotype: M.P.N./ S1 Department of Botany, Institute Science, Nagpur

Locality : Singhpur, M.P. India

Horizon : Deccan Intertrappean series of Central India.

Age : Upper Cretaceous.

Explanation of Plate I, Figs.(1 to 4), Figs.1 to 2: showing complete seed with embryo,Fig. 3: showing well developed embryo, Fig.4: showing seed coat.

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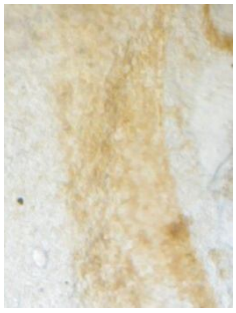

Fig. 1 Fig. 2 Fig. 3 Fig.4

Explanation of Text Figures 1 to 4, Text Figs. 1-2: showing well developed embryo in the seed, showing complete structure of seed with seed coat and embryo, Text Fig. 3: showing cellular details of seed coat cells well preserved hexagonal and pentagonal cells. Text Figs.4: showing a Dicot embryo with two lobes.

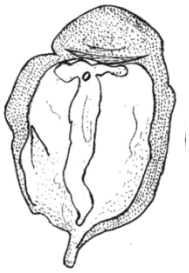
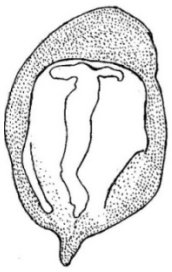
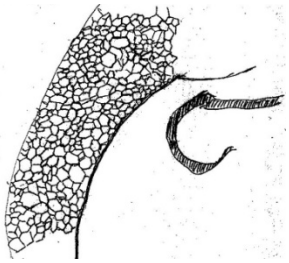

Fig. 1 Fig. 2 Fig. 3

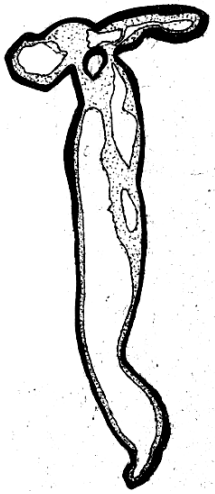

Fig. 4

0.1 mm
Fig. 1, 2

1 mm
Fig. 3, 4

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