1523. Convallaria. *Vern.*—Mítha dodiya; mithú; karimcha.

BULBS.—(Hills).

(2336) Kashmír (gul-i-sosan).

Kashmír (bekh zambak).

(2396) Kashmír (bekh sumbul).

(2062) Lahore (rishabha).

1524. Aloe indica. *Vern.*—Elwá; sibr; musabbar.

(1069A) Delhi.

(1309) Jálandhar (musabbir).

(1456) Amritsar.

(1656) Lahore (sibr).

Pattiala.

It has a powerful action on the uterus: is an emmenagogue and anthelmintic. It is considered cold and aperient, useful in affections of the spleen and liver, and fever; also in pain of the bowels. The pulp of the leaf is used in ophthalmia. Often used as a purgative.

Dose.—6 máshas. Price, 4 annas a seer.

A stimulating purgative, containing a neutral principle, aloesine; it acts especially on the lower intestines and womb. It is used in constipation, dyspepsia, jaundice, &c.

Dose.—grains 2 to 6.

1525. Aloe perfoliata. *Vern.*—Ban ustakí (Hindí medicine); ghíkwár; jívak pate.

(2133) Lahore.

(2148) Lahore (jívak pate).

The leaves are used by the natives externally in the treatment of rheumatism, abscess and ophthalmia, and internally in caries, and for coughs; also for diseases of the spleen and liver, and in fever.

1526. Asparagus racemosus. *Vern.*—Satáwar; bozandán; bozídán.

(651) Gurgaon.

(2072) Lahore (leaves).

(8A) Pattiala.

(1659) Lahore (bozandán).

(1009) Delhi (múslí safaid).

(1325) Jálandhar.

(1946) Lahore (múslí safaid).

(1499) Amritsar (múslí safaid).

Long cylindrical pieces of a tawny yellow semi-transparent appearance, longitudinally obliquely indented. Taste sweet and mucilaginous. It acts as a diuretic. The roots often pass as "múslí safaid."

Used in special diseases. Considered sweet and cool; it increases the appetite, and removes pains of the bowels; also to prevent confluence of small-pox. Used as food.

1527. Polyanthes tuberosa. *Vern.*—Shabbo; zambak.

(1653) Lahore.

(2084) Lahore (rajni gandhi, Hindí).

(1652) Lahore (zambak).

Considered by natives hot and dry, diuretic and useful after labor; also in rheumatism. Roots emetic, and used as a dressing for burns.

1528. Asparagus racemosus. *Vern.*—Satáwar; shatawar-ká-patta.

Considered by natives cool and moist; useful in special diseases, and disorders of the wind, bile and thirst.

1529. Asparagus sarmentosus. *Vern.*—Bozídan or bozandán.

(1971) Lahore.

MARANTACEÆ.

1530. Canna indica. Indian shot. *Vern.*—Hakík; karkota ka phal (in Hindí medicine).

(2065) Lahore.

The roots contain starch. The seeds are cordial and vulnerary; and are sometimes used for shot, and are strung for necklaces. Used as a diaphoretic and diuretic by natives in fevers and dropsy. AINSLIE. An allied species, *C. edulis*, yields the edibled root, known as "*tous lesmois.*"

CYPERACEÆ.

1531. Cyperus longus, rotundus, and many other species. *Vern.*—Nágar mothí; sá'ad kofí; motha; múthráh.

(2449) Kashmír.

(668) Gurgaon (sád kofí).

(1185) Ludhiana.

(1628) Lahore (motha).

(32A) Pattiala.

(2348) Kashmír (múthráh).

(1211) Simla.

(1631) Lahore (sád kofí).

(1419) Amritsar (múthra).

(1418) Amritsar (gharb gandhí).

(1627) Lahore (lunyáh).

Used for coughs and fever. Useful in fever and indigestion; also in disorders of blood and bile.

It contains a bitter principle, and is tonic, diaphoretic, and diuretic; it is also aromatic, and is said to become stronger on keeping; it is said to be useful in cholera.

Dose.—3 máshas. Price, 3 annas a seer.

GRAMINEACEÆ.

1532. Panicum miliaceum. *Vern.*—Chínáh; arzán.

(1619) Lahore.

(2293) Kashmír (rang ghás).

Used principally for food, especially after recovery from wounds.

1533. Pennisetum italicum. German millet. *Vern.*—Kangní.

(1007A) Simla.

(1621) Lahore.

Seeds small, delicate and wholesome. Used as a food. Considered by natives cool and dry, astringent and diuretic; used externally to relieve rheumatic pains. It is said to render beer more intoxicating.

1534. Cymbopogon aromaticus. *Vern.*—Khas; úsar; balam.

(1136) Sirsa.

(1456) Amritsar.

(1622) Lahore.

(2488) Jhínd.

(274A) Pattiala.

Considered by natives cool and astringent: useful in skin diseases, bilious affections, and special diseases. It is an aromatic stimulant, useful in fever, and to make tatties. The roots are dug up in March and April. Used as an aromatic in fever. Gives a fragrant oil.

Dose.—6 máshas. Price, 2 annas a seer.

1535. Andropogon iwarancusa. *Vern.*—Izkhar; khavi; gul-i-izkhar; lámjak (Hindí); ghatyárí (H.)

(1440) Amritsar.

(1625) Lahore.

(1626) Lahore (root).

(2488) Nabha.

(1625) Lahore.

(944) Dera Ghází Khán (katran, in original list).

(2153) Lahore (lámjak, Hindí).

Used for purifying the blood and in coughs; also in chronic rheumatism and cholera. Recommended as a valuable aromatic tonic in dyspepsia, especially of children. Used as a stimulant and diaphoretic, both by natives and Europeans in gout and rheumatism, and in fever.

Dose.—3 máshas. Price, 2 annas a seer.

1536. Oryza sativa. *Vern.*—Cháwál; dhán (for varieties, *see* the Agricultural Class).

(1320) Jálandhar.

(1614) Lahore.

A useful food, containing 85 per cent. of starch. It acts as a demulcent and diuretic. It is occasionally used in diseases of the urinary organs and catarrh; also externally as an application to burns and scalds.

1537. Sorghum vulgare. *Vern.*—Joár ki ar; dhúra or zúra, &c. (Arabic).

(1615) Lahore.

Nutritious. Considered by natives cool. Useful in bilious affections and special diseases; less heating than "bájra."

1538. Agrostis cynosurioides. *Vern.*—Dhúb ghás.

(1624) Lahore.

1539. Penicillaria spicata. *Vern.*—Bájra.

(1616) Lahore.

Supposed to be hot and dry, and to correct acidity in the stomach, but to be very heating, and therefore fitted for consumption in the winter months.

1540. Poa cynosurioides. *Vern.*—Dab; dúrva (Hindustání); kúsha (Sanscrit).

(1624) Lahore.

Used for food: also as a sacred offering among Hindús; and in affections of the urinary, bladder and calculus.

1541. Eleusyne corocana. *Vern.*—Mandwa; mandal or marwa.

Used as food, is one of the grains, which are lawful food for Hindús on fast days.

1542. Hordeum hexastichum. Barley. *Vern.*—Jau.

(1616) Lahore.

Used for food and for cases of sore throat. It contains gluten, starch and sugar. It acts as a laxative and demulcent, and is useful principally in fevers and inflammations; also in diseases of the bladder. When the husks are removed it is termed pearl barley.

1543. Saccharum officinarum. Raw Sugar. *Vern.*—Shakar surkh; khand.

(1623) Lahore.

(2022) Lahore (khand).

(927) Lahore.

Considered by natives heavy, tonic, and aperient. Useful in heat, delirium, disorders of bile and wind. A useful demulcent and article of food; chiefly used to add to other medicines to give them a pleasant flavor; but it has been recommended as an antidote in metallic poisoning, and in diarrhœa; and even in diabetes.

1544. Vermicelli. *Vern.*—Seviyán.

(1968) Lahore.

Used for purifying the blood.

1545. Gluten of wheat. *Vern.*—Nishásta.

(1620) Lahore.

(1010A) Pattiala.

Made by washing wheat flour. Used as an application for cutaneous diseases.

1546. Bambusa arundinacea. Bamboo (Silex from). *Vern.*—Tábashír; banslochan.

(4109) Lahore.

A siliceous concretion, found in the joints of the

bamboo; supposed to be cool and to remove thirst, fever and jaundice: it is in reality quite inert.

1547. Gardasiya.

(2033A) Lahore.

Dust from a flour mill which settles on the walls of the room or mill: it is used as a local application in headache.

1548. Flour. *Vern.*—Maida.

(2040) Lahore.

It is used as an emollient and demulcent, principally externally. It is applied to burns and scalds; also to erysipelatous surfaces; and occasionally it is employed as an antidote for cases of irritant mineral poisons, such as compounds of silver, mercury and iodine.

FILICES.

1549. Adiantum caudatum, venustum, and other species. *Vern.*—Par-i-siyá-washán: hansuráj.

(1345) Hushyarpúr.

(1196) Simla.

(1446) Amritsar.

(1612) Lahore.

(2224) Shahpúr (mubárak).

(2408) Kashmír.

(53A) Pattiala (hansráj).

(653) Gurgaon.

An astringent and aromatic; said to be emetic in large doses; also tonic and febrifuge. This is the fern which is used in making "capillaire" syrup.

Dose.—6 máshas. Price, 4 annas a seer.

1550. Polypodium. *Vern.*—Bisfaij.

(1480) Amritsar.

(1663) Lahore.

It is considered by natives that it purifies the blood in many diseases, especially of the skin, and acts as an emmenagogue. Root slightly purgative, saccharine and bitter.

Dose.—4 máshas. Price, 2 rupees a seer.

LICHENES.

1551. Parmelia chamchadalis. *Vern.*—Chailchalíra.

(1343) Hushyarpúr (chalíra).

(1447) Amritsar.

(1206) Simla.

(1610-1611) Lahore.

(2465) Kashmír.

Used for purifying the blood. Said to be a bitter tonic and astringent; used in intermittent fever and hæmorrhage. By hakíms it is used in dyspepsia, vomiting, pain in liver or womb, amenorrhœa, calculus, &c.

Dose.—3 máshas. Price, 2 annas a seer.

ALGÆ.

1552. Laminaria saccharina. *Vern.*—Gilarpatr.

(1607) Lahore.

Used in the cure of goitre: believed to be obtained from the Caspian sea. Is imported from Yarkand and *viá* Kashmír.

Dose.—1 másha. Price, 6 rupees a seer.

It contains much iodine, and acts as an alterative in scrofulous affections, and enlargement of the thyroid gland, goitre. If washed and hung up, a saccharine substance exudes.

Dose.—Grains 10 to 40.

DIATOMACEÆ.

1553. Diatomaceæ. *Vern.*—Hasan-i-Yusuf.

(1975) Lahore.

A minute siliceous shell of a triangular form, found floating on lakes and ponds in the hills of Kashmír, whence it is skimmed off and dried. Erroneously described by HONIGBERGER and others, as a seed.

FUNGI.

1554. Agaricus igneus. *Vern.*—Gháríkán.

(1608) Lahore.

Externally it is employed to stop bleeding from recent wounds; internally used as a purgative and anthelmintic.

It contains a peculiar resin: said to be useful in indurations of the liver and spleen, ague, epilepsy, and the bites of scorpions; also all bilious and mucous disorders. In reality it only acts mechanically.

Dose.—3 mashas. Price, 10 rupees a seer.

1555. Pad Bahera.

(1608) Lahore.

Is said to produce insensibility.

1556. Morchella esculenta (edulis). *Vern.*—Giri-chatra (Hindí); samárogh.

(2129) Lahore.

(1967) Lahore (samárogh).

Wholesome and agreeable: used as a sauce and as food.

1557. Morel. *Vern.*—Káná kachu; khat karwa (?)

(2024) Lahore.

(For an account of Morels, *see* p. 258).

JUGLANDACEÆ.

1558. Juglans regia. Walnut. *Vern.*—Akrot.

(1313) Jálandhar.

(1681) Lahore.

A warm and dry medicine: used in food and in special diseases, and rheumatism.

Dose.—3 máshas. Price, 8 annas a seer.

BARK.—Dandása.

(1682) Lahore.

(2474) Kashmír.

(2181) Rawalpindi (chál akhor).

It is said to be anthelmintic. The leaves are said to be astringent, tonic and to have almost a specific effect in curing strumous sores, in a decoction. Used as a dye; also as an astringent for piles. The bark of "rítha" *(Sapindus acuminatus)* is sometimes substituted. It is said to be emetic, and externally rubefacient. It has been used in scrofula and syphilis. It is also used as a dentrifice to clean and strengthen the teeth and gums. A twig of the tree is said to dispel flies. The juice from the roots is said to relieve pain from stone or gravel, toothache or gout.

Dose.—Price, 10 annas a seer.

MYRICACEÆ.

1559. Myrica sapida. *Vern.*—Kaiphal; kahi kahela?

(1018A) Delhi.

(1525) Amritsar.

(66A) Pattiala.

(5093) Simla.

(2031) Lahore.

A warm dry remedy: used in epilepsy and after confinements.

Dose.—6 máshas. Price, 3 annas a seer.

AMENTACEÆ.

1560. Salix babylonica. *Vern.*—Majnún.

(1665) Lahore.

(2061) Lahore (nilabara in Hindí medicine).

The bark is quilted, dark-colored, fibrous and tough. It contains a neutral principle, called salicine, and tannic acid: it acts as an astringent and tonic, and is principally used in intermittent and other fevers. Some consider it nearly equal to cinchona. It is also said to be anthelmentic. (TROUSSEAU).

Dose.—Grains 20 to 30.

1561. Salix Ægyptiaca. *Vern.*—Bed mushk.

(1664) Lahore.

(2389) Kashmír.

(2157) Lahore.

A cold remedy: used for palpitation of the heart and insanity. The natives make a willow flower water, or "'ark bed mushk," to which they ascribe all sorts of virtues and cooling properties. It is much used in sherbet, and is a regular article of trade.

Price, 8 annas a seer.

1562. Populus alba. *Vern.*—Sufaida; baid (?)

(2035) Lahore.

(2036) Lahore.

It contains some salicine and acts as a tonic: used for purifying the blood and in skin diseases. Bark said to be useful in strangury.

Dose.—1 tolah.

1563. Quercus incana. Acorn of. *Vern.*—Balút; síl supárí.

(1377) Jálandhar (bán, the wood).

(1678) Lahore.

(2333) Kashmír (síla supári).

Used for indigestion, diarrhœa and asthma. Recommended for chronic diarrhœa in children, after burying in the earth to remove their bitter principle, then washing and grinding.

Dose.—3 máshas. Price, 4 annas a seer.

1564. Corylus avellana. Nut. *Vern.*—Findak; bindak.

(1679) Lahore.

(1001A) Delhi.

(2308) Kashmír.

(1006A) Delhi.

(2275) Dera Ghází Khán (kanjua).

Contains much oil. Used for coughs and special diseases.

Dose.—6 máshas. Price, 4 annas a seer.

1565. Betula tartarica. Birch. *Vern.*—Bhojpatr.

(1663) Lahore.

Used in sprains and bruises. The bark of this plant can easily be separated into thin leaves, like paper; it is largely used in Kashmír instead of paper, and also to line clothes. It is said to be useful in disorders of the bile and blood, also earache, and possession by evil spirits.

The inner bark is largely used in Kashmír, as it is said to prevent humidity. It is used to pack drugs, to stop the mouths of bottles, and envelope shawls.

1566. Balanophora? *Vern.*—Gochamúl.

(2344) Kashmír (in Vernacular Catalogue, "gargazmúl.")

ADDENDA TO THE DRUGS.

Menispermaceæ. The name "páth" is also applied to a **Cissampelos** (*see* page 325).

"Pálak," given as **Spinachia olerracea** is often **Beta bengalensis** (*see* **1449**, page 372).

"Pakhán bed" is often **Saxifraga ligulata** (*see* **1367**, page 362).

"Todrí náfarmání" is often **Delphinium** (*see* page 327).

"Chimote" or "chirmati" is **Michelia champaca.**

"Detar dána," given as **Hedysarum** in the foregoing, should be **Uraria picta.**

Cuscuta reflexa. "Niradhar" of Gujrát, is supposed to be "nílá tár" ("the green thread"), (*see* **1423**, page 367).

Dolomœa macrocephala, is "dhúp."

Leucas cephalotes is "seselyús maldoda," or "chatra."

Centaurea moschata is "shah pasand" or "lál dána" (**1315**, page 355).

Verbena officinalis is "karaita" (*see* **1388**, page 364).

Aucklandia costus. Other names are—"kust shírín," "kust bahrí," "asinn" (*see* **1319**, page 356).

Pluchia is the "majni" of Dera Ghází Khán.

Cocos seychellarum, is the large daryaí narel," of the shells of which fakírs make their bowls, called "chippí."

REPORT ON THE CHEMICAL AND PHARMACEUTICAL SUBSTANCES.

SECTION A. CLASS III.

DIVISION II.

THE JURY CONSISTED OF THE FOLLOWING GENTLEMEN:—

W. GREEN, ESQ., M.D., *Dep. Inspr. Genl.*
H. ELTON, ESQ., M.D., *Medical Store Keeper, Sealkot.*
J. SCRIVEN, ESQ., *Principal, Medical College, Lahore.*
A. M. DALLAS, ESQ., *Inspr. Genl. of Jails.*
J. PENNY, ESQ., M.D., *Offg. Civil Surgeon, Lahore.*
B. POWELL, ESQ., C.S., *Curator, Central Museum.*
J. BARTLEMY, ESQ., *Apothecary to the Citadel.*
RAM SING, *Drug Merchant, Lahore.*
MUHAMMED ISMAIL BASHI, *Manufacturer of Chemical Substances.*

REPORTER—DR. BROWN, *Professor of Chemistry, Medical College, Lahore.*

THIS division contains only the vegetable drugs, the medicaments derived from mineral and animal kingdoms are included in separate classes, and the mineral drugs have been considered in a separate report. The animal drugs, however, were too few in number to require a separate jury, and so have come under consideration of this. Including then, both mineral and animal drugs, the total number of drugs exhibited was 2039. These 2039 specimens may be divided into 247 drugs, derived from the mineral kingdom, which are described elsewhere; 1751 derived from the vegetable kingdom; and 41 drugs obtained from the animal kingdom; which two latter divisions form the subject of this report.

The following districts contributed specimens to the Exhibition:—

Districts.	Vegetable.	Animal.	Districts.	Vegetable.	Animal.
Gugaira, ...	68	1	Gugaira, ...	1	4
Hissar, ...	7	0	Jhang, ...	0	0
Rohtak, ...	0	0	Dera Ismail Khán, ...	57	0
Ambálah, ...	24	0	Dera Ghází Khán, ...	49	0
Ludhiana, ...	52	0	Peshawur, ...	0	0
Simla, ...	49	7	Kuhát, ...	0	0
Jálandhar, ...	126	4	Faridkhót, ...	0	0
Hushyarpúr, ...	30	0	Delhi, ...	202	0
Kangra, ...	0	3	Sirsa, ...	5	0
Amritsar, ...	189	2	Hazára, ...	2	1
Lahore, ...	593	16	Kashmír, ...	203	3
Gujranwalla, ...	6	0	Muzaffargarh, ...	7	0
Rawalpindi, ...	21	0	Jhind, ...	6	0
Gujrát, ...	23	0	Nabha, ...	14	0
Jhilam, ...	8	0	Gurdaspúr, ...	47	0
Shahpúr, ...	8	0	Pattiala, ...	84	0

No prize was allotted for the jury on vegetable drugs to distribute; but as many of the collections had been made with great care and diligence, the jury would strongly recommend that two Silver Medals, and seven Certificates of Honor be awarded to the various collectors of the drugs, in the manner mentioned below.

1st. That a Silver Medal and Certificate be awarded for the very extensive and admirably arranged collection of drugs from Lahore, which includes nearly one-third of the total number of drugs exhibited; together with a Certificate to PUNDIT RADA KISHN, for his Hill Drug Collection.

2nd. That a Silver Medal and Certificate be awarded also for the collection from Delhi, which has been most carefully labelled, and placed in suitable boxes; while at the same time it contains a large number of interesting specimens.

They would also recommend that Certificates of Honor be given for the collection of drugs made in the Hushyarpúr district, as well as for that from the Gújrat district, both of which, though consisting of only comparatively few specimens, have been selected with care, and are composed of remarkably good specimens, very distinctly labelled.

Also that a Certificate of Honor be given for each of the collections sent from the native states of Kashmír and of Pattiala, each of which is numerous, and contains several drugs of interest; and also one for the collection sent by DR. CLEGHORN, of carefully selected Hill Drugs.

Among these two thousand specimens, a large number are duplicates; others are only employed in native medicine for ailments which are better treated by moral means in European practice; but a considerable number remain which are really useful, and are employed in medicine, and extensively sold in the London market. Of these a list is subjoined, in which the current price, as extracted from the "Public Ledger," of February 17th, 1866, (the latest and best authority) is given. From this it may be seen that the following drugs might be advantageously sent from the Punjab to England:—Kino, gum acacia, til seed, poppy seed, gum tragacanth and scammony; while salep, euphorbium, and asphalt could be imported from England with advantage. But there are other drugs, the sale of which is not so great as to require a notice in the price current sent, which will be mentioned afterwards.

COMPARISON OF ENGLISH AND PUNJAB.

English name.	Indian name.	English price.	Indian price.	Remarks.
Asphalt, ..	Zift-i-rúmi, ..	Rs. 7 per cwt.	Rs. 5 per seer.	
Mimosa bark, chopped, ..	Kíkar-ki-chál, ..	„ 135 per ton.	„ 12 per md.	
Brimstone, rough, ..	Gandak, ..	„ 80 „	„ 16 „	
„ roll, ..	„ ..	„ 100 „		
Alum, ..	Phitkarí, ..	„ 67-8 „	„ 7-11 „	
Antimony ore, ..	Surma, ..	„ 100 „	„ 15 „	
Arsenic, lump, ..	Sankhyá, ..	„ 8 per cwt.	„ 50 „	
Borax, E. I., ..	Sohaga, ..	„ 9 to 22 per cwt.	„ 16 „	
Camphor, ..	Kapúr, ..	„ 0-12 per lb.	„ 2 per seer.	
Copperas, green, ..	Hira kasís, ..	„ 27-8 per ton,	„ 5 per md.	
Corrosive sublimate, ..	Raskapúr, ..	„ 0-15 per lb.	„ 6 per seer.	
Minium, ..	Sandúr, ..	„ 10-8 per cwt.,	„ 16 per md.	
Sal ammoniac, ..	Naushadar, ..	„ 18 per cwt.,	„ 20 „	
Saltpetre, refined, ..	Shora kalmí, ..	„ 20 per cwt.,	„ 4 to 10 per md.	
Aniseed, ..	Badián khatai, ..	„ 65 „	„ 30 „	

English name.	Indian name.	English price.	Indian price.	Remarks.
Cassia fistula, ..	Ambaltás, ..	Rs. 10 to 17 per cwt.	„ 3 per maund.	
Castor oil seeds, ..	Arend-ka-bij, ..	„ 6-8 to 7 „	„ 3 „	
Colocynth, ..	Hanzil, ..	„ 0-4-6 to 0-8-0 p. lb.	„ 8 per seer.	
Croton seed, ..	Jumalgotá, ..	„ 35 to 40 per cwt.	„ 20 per md.	
Cubebs, ..	Kubáb chini, ..	„ 46 to 48 „	„ 50 „	
Cummin seed, ..	Zíra safaid, ..	„ 11 to 17-8 „	„ 10 „	
Fenugreek seed, ..	Methí, ..	„ 5-8 to 7-0 „	„ 2-8 „	
Galangal root, ..			„ 12 „	
Hellebore root, ..	Kali kátki, ..	„ 13 „	„ 8 „	
Juniper berries, ..	Hauber, ..	„ 3 to 4-8 „	„ 8 „	
Munjíth, ..	Mánjíth, ..			
Safflower, ..	Kussumbha, ..	Rs. 42 to 82-8 per cwt.		
Gum tragacanth, ..	Katíra gond, ..	Rs. 90 to 125 per cwt.	„ 40 per md.	
Indigo, ..	Nil, ..	Rs. 1-4 to 3-12 per lb.	„ 12-8 per 5 seers.	
Lac, ..	Lakh, ..	Rs. 72 to 81 per cwt.	„ 60 per md.	
Pumice stone, ..		„ 55 to 90 „		
Sago, ..	Ságudána, ..	„ 8-8 to 10-8 „	„ 10 per md.	
Salt, ..	Nímak, ..	„ 1-12 to 2-12 p. ton		
Caraway seed, ..	Zíra, ..	„ 14 to 17 per cwt.	„ 10 per seer.	
Coriander, ..	Dhanya, ..	„ 5-0 to 7-0 „	„ 3 per md.	
Hemp, ..	Sann, ..	„ 18-8 to 20 p. bdle.	„ 5 per seer.	
Mustard, brown, ..	Rai, ..	„ 3-8 to 6 per barl.	„ 3 per md.	
„ white, ..	Sarson, ..	„ 4-0 to 5 „	„ 4 „	
Poppy seed, ..	Khashkásh, ..	„ 25-8 per quarter.	„ 3-4 „	
Til, ..	Til, ..	„ 29-8 to 31.	„ 3 „	
Cotton, ..	Rui-ke-bij, ..	„ 75 to 77-8 p. ton	„ 2 „	
Cassia lignea, ..	Kirfa, ..	„ 42-8 to 47 p. cwt.	„ 40 „	
Cinnamon, ..	Darchini, ..	„ 0-8 to 0-14 p. lb.	„ 1 per seer.	
Ginger, ..	Soúth, ..	„ 22-8 per cwt.	„ 14 per md.	
Mace, ..	Jawantri, ..	„ 0-8 to 1-0 p. lb.	„ 3 per seer.	
Nutmeg, ..	Jaiphal, ..	„ 0-8 to 1-0 p. lb.	„ 2 „	
Pepper, ..	Gol mirich, ..	„ 0-3-6 per lb.	„ 0-7-0 „	
Cayenne pepper, ..	Lal mirich, ..	„ 0-6-6 to 0-13 p. lb.	„ 0-4-0 „	
Long pepper, ..	Pipla, ..	„ 15-8 per cwt.	„ 17 per md.	
Wax, ..	Mom, ..	„ 115 to 125 p. cwt.	„ 50 „	
Red sandal wood, ..	Rakhta chandan? ..	„ 57 per cwt.	„ 10 „	
Sappan wood, ..	Bakm, ..	„ 30 per cwt.	„ 6 „	
Musk, ..	Mushk, ..	„ 12 per ounce.	„ 25 p. chittack.	
Myrobalans, ..	Triphulla, ..	„ 93 to 121 per cwt.	„ 2-8 per md.	
Nuxvomica, ..	Kuchila, ..	„ 147 to 158 „	„ 10 „	
Orris root, ..	Bekh sosan, ..	„ 270 to 15 „	„ 14 „	
Pelitory root, ..	Akarkarha, ..	„ 32 „	„ 31 „	
Rhubarb, ..	Rewand, ..	„ 0-12-0 per lb.	„ 7 „	
Salep, ..	Salep misri, ..	„ 60 to 62-8 p. cwt.	„ 8 per seer.	
Scammony, ..	Sakmúniyá, ..	„ 16 per lb.	„ 5 „	
Senna, ..	Sanna makhi, ..	„ 0-2-0 to 0-4-0 p. lb.	„ 0-4-0 „	
Tamarinds, E. I., ..	Imlí, ..	„ 7-4 to 7-8 p. cwt.	„ 5 per md.	
Galls, ..	Majúphal, ..	„ 60 to 65 p. cwt.	„ 50 „	
Almonds, ..	Bádám, ..	„ 24 to 26 „	„ 12 „	
Figs, ..	Anjír, ..	„ 14 to 35 „	„ 16 „	
Raisins, ..	Kishmish, ..	„ 19 to 23-8 „	„ 8 „	
Dates, ..	Chuhhára, ..	„ 5-8 to 7 „	„ 10 „	
Gum arabic, ..	Kíkar-ki-gond, ..	„ 30 to 34 „	„ 12 „	
„ assafœtida, ..	Hing, ..	„ 12-8 to 35 „	„ 14 „	
„ benzoin, ..	Lubán, ..	„ 230 to 320 „	„ 80 to 100 per md.	
„ dammar, ..	Dammar, ..	„ 17-8 to 27-8 „	„ 14 „	
„ euphorbium, ..	Farbiyúm, ..	„ 7-8 to 8-8 „	„ 5 per seer.	
„ gamboge, ..	'Usárá rewand, ..	„ 75 to 85 „	„ 80 per md.	
„ kino, ..	Kamarkas, ..	„ 150 to 200 „	„ 10 to 16 per md.	
„ mastic, ..	Mustagí, ..	„ 2-8 per lb.	„ 2-8 per seer.	
„ myrrh, ..	Bol, ..	„ 35 to 75 per cwt.	„ 100 per md.	
„ sundrach, ..	Sundras, ..	„ 42-8 to 51 „	„ 20 to 40 „	

NOTE.—It is to be remembered that these prices change much from time to time: the list serves to show the general quotation of price.

Although the price of a large number of these drugs is too close to that at which they are procurable in England, to allow of their being exported with advantage from the Punjab, yet there can be no doubt but that it would be much cheaper for Government to purchase them for the Mofussil Medical Depôts on the spot, instead of buying them in England and conveying them from England to Calcutta, and from Calcutta to the Punjab. This remark would only apply to such drugs as are imported from England, such as kino, gum acacia, &c. But there is a large number of medicines, of which many are usually obtained from the bazar; and a list is therefore subjoined of those which are at present more or less frequently used in medicine; also of those which were formerly so employed, and those which require a further trial, as their medicinal properties are not yet fully ascertained, or at least generally known among practitioners in India. The mark (B.P.) has been added to designate those medicines which have been admitted into the British Pharmacopœia recently published.

Drugs used now.	Drugs formerly used.	Drugs recommended for trial.
Aconitum ferox.	Nigella sativa.	Thalictrum foliosum.
„ heterophyllum.	Pœonea corallina.	„ momecra.
Cocculus cordifolius.	Malva rotundifolia.	Argemone mexicana.
Papaver somniferum (B. P.)	Althœa rosea.	Bombax heptaphyllum.
Illicium anisatum (B. P.)	Viola serpens.	Vateria indica.
Sinapis alba (B. P.)	Oxalis corniculata.	Peganum harmala.
„ nigra (B. P.)	Rhus coriaria.	Ruta augustifolia.
Shorea robusta.	Helicteres isora.	Celastrus paniculatus.
Cochlospermum gossypium.	Trigonella fœnumgræcum.	Alhagi maurorum.
Sapindus acuminatus.	Abrus precitorius.	Xanthoxylon hostile.
Berberis lycium.	Mucuna pruritis.	Barringtonia acutangula.
Linum usitatisimum (B. P.)	Cæsalpinea sappan.	Tamarix gallica.
Garcinia sp———. (B. P.)	Pterocarpus draco.	Hyperanthera pterygosperma.
Ægle marmelos (B. P.)	Terminalia chebula.	Nima quassoides.
Citrus aurantium (B. P.)	„ citrina.	Zyzyphus jujuba.
„ limonium (B. P.)	„ bellerica.	Semecarpus anacardium.
Melia azadirachta.	Apium involucratum.	Pistacia integrifolia.
Amyris commiphora.	Ptychotis ajwain.	Prinsepia utilis.
Ruta angustifolia.		Lawsonia inermis.
Pistacia lentiscus (B. P.)	Emblica officinalis.	Ptychotis ajwain.
Butea frondosa.	Pistacia vera.	Carum gracile.
Indigofera tinctoria (B. P.)	Myrtus communis.	Rubia mungista.
Acacia vera (B. P.)		Morina Wallichiana.
Glycyrrhiza glabra (B. P.)	Opoponax cheironum.	Randia dumetorum.
Acacia catechu (B. P.)	Lactuca.	Valeriana sp———.
Cathartocarpus fistula (B. P.)	Chicorium intybus.	Serratula anthelmintica.
Cassia elongata (B. P.)	Centaurea behmen.	Fraxinus floribundus (manna).
Tarmarindus indica (B. P.)	Strychnos Ignatii.	Picrorhiza kurrooa.
Guilandina bonducella.	Wrightea antidysenterica.	Nerium odorum.
Amygdalus communis (B. P.)	Hollarrhena antidysenterica.	Nicandra indica.
Prunus domestica (B. P.)	Solanum nigrum.	Symplocos racemosa.
Rosa centifolia (B. P.)	Hyssopus officinalis.	Ocymum sanctum.
Cydonia vulgaris.		„ pilosum.
Caryophyllus aromaticus (B. P.)	Ipomea turpethum.	„ basilicum.
Punica granatum (B. P.)	Plumbago zeylanica.	Plumbago ispagula.
Narthex assafœtida (B. P.)	Polygonum bistorta.	Embelia ripes.
Cuminum cyminum.	Datisca cannabina.	Myrica sapida.
Anisum vulgare.	Emblica officinalis.	Andropogon aromaticum.
Pimpinella anisum.	Euphorbia officinalis.	Vitex negundo.
Daucus carota.	Aristolochia longa.	Gmelina arborea.
Anethum sowa.	„ rotunda.	Cuscuta reflex.
Fœniculum vulgare (B. P.)	Santalum alba.	Cordia myxa.
	Cupressus sempervirens.	Myrsine africana.

Drugs used now.	Drugs formerly used.	Drugs recommended for trial.
Coriandum sativum (B. P.)	Pœnœa sarcocolla.	Eleagnus orientalis.
Narthex assafœtida (B. P.)	Eulophia sp.———— ?	Myrica sapida.
Dorema ammoniaca (B. P.)	Smilax china.	Parmelia chamchadulis.
Opoponax chironum.	Curcuma zerumbet.	Commelyna scapiflora.
Citrullus colocynthus (B. P.)	Curcuma zedoaria.	Hedychium spicatum.
Valeriana jatamansi.	Alpinia galanga.	Costus speciosus.
Lactuca sativa.	Iris florentina.	Cymbopogon aromaticum.
Carthamus tinctoria.	Colchicum illerium.	Andropogon iwarancusa.
Matricaria chamomilla.	Cyperus longus.	
Anthemis pyrethum.	Adiantum capillus veneris.	
Artemisia indica.	Polypodium.	
Styrax benzoin (B. P.)	Agaricus igneus.	
Strychnos nuxvomica (B. P.)	Allium sativum.	
Strychnos potatorum.		
Calotropis procera.		
„ gigantea.		
Hemidesmus indica (B. P.)		
Ophelia chirayta (B. P.)		
Gentian.		
Solanum tuberosum.		
Physalis somnifera.		
Capsicum fastigiatum (B. P.)		
Datura fastuosa.		
„ metel.		
Hyoscyamus nigra (B. P.)		
Solanum dulcamara (B. P.)		
Sesamum orientale.		
Mentha viridis (B P.)		
Onosma echioides.		
Convolvolus scammonia (B. P.)		
Ipomea cærulea.		
Plantago ispagula.		
Rheum sp———— ? (B. P.)		
Myristica officinalis (B. P.)		
Camphora officinum (B. P.)		
Laurus cassia.		
„ cinnamomum (B. P.)		
Cinnamomum albiflorum.		
Croton tiglium (B. P.)		
Ricinus communis (B. P.)		
Rottleria tinctoria (B. P.)		
Piper nigrum (B. P.)		
Piper longum.		
Piper cubeba (B. P.)		
Morus nigra (B. P.)		
Cannabis indica (B. P.)		
Salix.		
Quercus galls (B. P.)		
Pinus sp———— (turpentine.)		
Acorus calamus.		
Phœnix dactilyfera.		
Zinziber officinale (B. P.)		
Curcuma longa (B. P.)		
Elettaria cardamomum (B. P.)		
Crocus sativus (B. P.)		
Allium cepa.		
Scilla sp———— (B. P.)		
Aloe indica.		
Oryza sativa.		
Hordeum hexastichon (B. P.)		
Saccharum officinarum (B. P.)		

It has been thought desirable also to append a list of all the vegetable drugs ordered in the new Pharmacopœia, with the substitutes which can be obtained in the Punjab for

each of these; and it will be remarked how few vegetable drugs there are for which substitutes cannot readily be obtained in the Indian bazars.

The following list is subjoined of all the vegetable drugs admitted into the British Pharmacopœia, with the substances which may be used with good effect in India as substitutes, and the scientific name of the latter.

Drugs ordered in the British Pharmacopœia.	Native name of substitute.	Scientific name of substitute.
Acacia,	Gond kíkar,	Acacia arabica.
	Gond-i-phulahi,	Acacia modesta.
	Gond-i-zárdalú,	Prunus domestica.
Aconiti radix,	Mítha bish,	Aconitum ferox.
Aconitum,		
Aloe barbadensis,	Musabbir,	Aloe indica.
„ socotrina,		
Ammoniacum,	'Ushk,	Dorema ammoniacum.
Amygdala,	Bádám,	Amygdalis communis.
Amylum,	Nisbásta,	Amylum.
Anethum,	Sowa,	Anethum sowa.
Anthemis,	Bábúnah,	Matricaria chamomilla.
Armoracia,	Sohánjna,	Hyperanthera pterygosperma.
Arnica,		
Assafœtida,	Híng,	Narthex assafœtida.
Aurantii cortex,	Náringí,	Citrus aurantum.
Balsamum canadense,	Ganda baroza,	Pinus longifolia (turpentine).
„ peruvianum,	Lubán,	Styrax benzoin.
„ tolulanum,		
Belladonna,	Dhatúra,	Datura fastinosa.
„ radix,		
Benzoinum,	Lubán,	Styrax benzoin.
Bucco,	Barg morad,	Myrtus communis.
Cajeputi, oleum,		
Calumba,	Gilo,	Tinosperma cordifolia.
Cambogia,	Usárah rewánd,	Garcinia sp———.
Camphora,	Kafúr,	Laurus camphora.
Cannabis indica,	Ganjah,	Cannabis indica.
Capsicum,	Lál mirich,	Capsicum fastigiatum.
Cardamomum,	Iláchí,	Elettaria cardamomum.
Carum,	Zíra síah,	Carum gracile.
Caryophyllum,	Laung,	Caryophyllus aromaticus.
Cascarilla,	Warch,	Acorus calamus.
Cassia,	Ambaltás,	Cassia fistula.
Catechu nigrum,	Kat,	Acacia catechu.
„ pallidum,		
Cetraria,	Chalchalíra,	Parmelia chamchadalis.
Chiretta,	Ispagol, chiraita,	Plantago ispagula, Ophelia cheretta.
Cinchona sp———.	Atís,	Aconitum heterophyllum.
	Rasaut,	Berberis lycium.
Cinnamomum,	Dár chini,	Cinnamomum officinarum.
Cocculus,	Kákmáchi,	
Colchici cortex et semen,	Surinján,	Colchicum illyricum.
Colocynthus,	Hanzil,	Cucumis colycynthus.
Conium (and fructus),	Dhatura,	Datura fastuosa.
Copaiba,	Kabab chíní,	Piper cubeba.
Coriandrum,	Dhaniya,	Coriandrum sativum.
Cotton,	Rúi,	Gossypium herbaceum.
Crocus,	Kesar,	Crocus sativus.
Cubeba,	Kabáb chíni,	Piper cubeba.
Cusparia,	Kath karanjwa,	Guilandina bonducella.
Cusso,	Kamíla,	Rottlera tinctoria.
Digitalis,		
Dulcamara,	Rúba bárík,	Solanum dulcamara.
Elaterium,	Jamálgota,	Croton tiglium.

Drugs ordered in the British Pharmacopœia.	Native name of substitute.	Scientific name of substitute.
Elemi, ..	Anzarút, ..	Pœnea sarcocolla.
Ergota,		
Ficus, ..	Anjír, ..	Ficus carica.
Filix, ..	Bisfaij, ..	Polypodium.
	Kamíla, ..	Rottlera tinctoria.
Fœniculum, ..	Soňf, ..	Fœniculum vulgare.
Galbanum, ..	Jawáshir, ..	Opoponax chironum.
Galla, ..	Májuphal, ..	Gall of quercus.
	Máiń choti and bari, ..	Gall of tamarix.
Gentian, ..	Gentian, pakan bed, ..	Gentian.
	Kaur, ..	Picrorrhiza kurrooa.
Glycyrrhiza, ..	Mulaṫṫhí, ..	Abrus or Glycyrrhiza.
Granati radix, ..	Anár ka jar, ..	Punica granatum.
Guaiaci lignum et resina, ..	..	
Hæmatoxylum, ..	Saki, ..	Bark of Cassia fistula.
Hemidesmus, ..	Anantamúl, ..	Hemidesmus indica.
Hordeum, ..	Jau, ..	Hordeum hexastichon.
Hyoscyamus, ..	Khorásání ajwain, ..	Hyoscyamus niger.
Indigo, ..	Nil, ..	Indigofera tinctorium.
Ipecacuanha, ..	Madár, ..	Calotropis procera.
Jalapa, ..	Káládána, ..	Pharbitis nil.
Kameela, ..	Kamíla, ..	Rottlera tinctoria.
Kino, ..	Gond dák, ..	Butea frondosa.
Krameria, ..	Saki, ..	Bark of Cassia fistula.
Lauro-cerasus, ..	..	
Limoni cortex, ..	Khatta, ..	Citrus limonum.
Lini semen et farina, ..	Alsí, ..	Linum usitatissimum.
Litmus, ..		
Lobelia, ..	Támákú, ..	Nicotiana tabacum.
Manna, ..	Sherkhist, ..	Manna of Fraxinus.
	Turanjbín, ..	„ Alhagi maurorum.
	Shakkar taghár, ..	„ Calotropis procera.
Masticha, ..	Rúmí mustagi, ..	Pistacia lentiscus.
Matica, ..		
Mezereum, ..	Sannarkat, &c.,	Daphne sp.——
Mori succus, ..	Tút, ..	Morus indica.
Myristica, ..	Jaiphal, ..	Myristica officinalis.
Myrrha, ..	Bol, ..	Balsamodendron myrrha.
Opium, ..	Afím, ..	Opium.
Papaver, ..	Post, ..	Papaver somniferum.
Pareira, ..		
Pimento,* ..		
Piper, ..	Gol mirich, ..	Piper longum.
Pix burgundica, ..	Ganda baroza, ..	Pinus longifolia (resin).
Pix liquida, ..	Zift-i-rúmí, ..	Pix.
Podophyllum, ..		
Prunus, ..	Alúcha, ..	Prunus domestica.
Pterocarpus, ..	Rakta chandan, ..	Pterocarpus santalinus.
Quassia, ..	Atís, ..	Aconitum heterophyllum.
	Chiraita, ..	Ophelia chiretta.
	Farangí, ..	Nima quassoides.
Quercus, ..	Dandása, ..	Bark of Juglans regia.
Resina, ..	Rál safaid, ..	Shorea robusta.
Rheum, ..	Rewand, ..	Rheum sp———.
Rhœas, ..	Kusumbha, ..	Carthamus tinctoria.
Rosa canina, ..	Gul khand, ..	Conserve of roses.
„ centifolia, ..	Guláb, ..	Rosa.
„ gallica, ..	Guláb surk, ..	„
Sabadilla, ..		
Sabina, ..		
Saccharum, ..	Khand, ..	Saccharum.
Sambucus, ..	Motia, ..	Jasminum zambac.
Santonica, ..	Afsantín, ..	Artemisia indica.

* Obtainable from the South of India.

Drugs ordered in the British Pharmacopœia.	Native name of substitute.	Scientific name of substitute.
Sarsa,	Anantamúl,	Hemidesmus indica.
Sassafras,		
Scammonii radix,	Sakmúníyá,	Convolvulus scammonium.
Scammonium,		
Scilla,	Ishill,	Scilla indica.
Scoparius,		
Senega,		
Senna Alexandrina, Indica,	Sanna makkí,	Cassia elongata.
Serpentaria,	Muthra, motha,	Cyperus sp———.
Sinapis,	Sarson,	Brassica campestris.
	Rai,	„ juncea.
Stramonii, folia et semen,	Dhatúra,	Datura alba.
Styrax,	Lubán,	Styrax benzoin.
Tabacum,	Tamákú,	Nicotiana tabacum.
Tamarind,	Imlí,	Tamarindus indica.
Taraxacum,	Pili jarí,	Thalictrum foliosum.
Theriaca,	Khand,	Saccharum.
Thus americanus,		
Turmeric,	Haldí,	Curcuma longa.
Ulmus,		
Uva ursi.		
Uvæ,	Kishmish,	Vitis vinifera.
Valerian,	Dálá,	Valeriana sp———.
	Bálchir,	Nardostachys jatamansi.
Zingiber,	Sonth,	Zingiber officinale.

From the above lists it will be observed how large a proportion of the vegetable drugs of the present Pharmacopœia are either themselves obtainable in the Punjab, or have efficient substitutes there obtainable; and, therefore, that small dispensaries might be able to obtain most of their vegetable drugs from sources in India, without putting Government to a large expense for importing drugs; and this especially applies to the Punjab more than the most parts of India, since the expense of the land carriage is much greater. It must be remembered, however, that it is only the simple remedies which are so obtainable, and that many of the preparations of these cannot be always advantageously made at small dispensaries; while some of the most important preparations cannot be made at all at present, such as sulphate of quinine, but it is hoped that the plant which produces it will soon be entirely naturalized in the hills.

As an appendix to the above Report, it may be added that a small compilation on the action and uses of the medicines usually found in the Punjab bazars would be of great service in instructing officers attached to dispensaries (especially those who have recently arrived in this part of India), in the medicaments of which they can avail themselves, and the uses to which such may be applied. Such a compilation would describe all the useful drugs ordinarily available in the Punjab, the mode of recognising them, their action and uses, and the best mode of preparing them for administration.

T. E. B. BROWN, M.D.,

Reporter to the Jury.

CLASS IV.—SUBSTANCES USED IN MANUFACTURES.

SUB-CLASS (A). GUMS AND RESINS.

This class may be subdivided into—

I. True gums, known by their solubility in water.

II. *Gum resins*, not soluble in water, but soluble in alcohol.

III. *Resins*, inflammable substances, soluble in alcohol, ether and volatile oils. They exude from the trees, and become solid by combination with the oxygen of the air.* Useful in arts for varnishes. This includes also—Balsams and oleo-resins.

Balsams are semi-solid or liquid exudations from plants, and containing either benzoic acid or an essential oil, or both. The liquid balsams, of which the most used are the balsam of copaiba, &c., are unrepresented in the collection. There are two solid balsams included—Benjamin or styrax, and dragon's blood (*Pterocarpus draco*), (*not Draccena draco*).

Oleo-resins are resins combined with volatile oils: on distillation the oil passes over, leaving a resin behind. The class is represented by turpentine, or ganda biroza, "chil ka gond."

IV. Elastic gums.

Scarcely represented in the Punjab, save by the *Calotropis procera* (*Hamiltonii*), whose juice will yield a substitute for gutta percha. The Madras Presidency illustrated this section in the Exhibition of 1864, by a specimen of *Euphorbia* gutta percha (*Euphorbia antiquorum*), and a sample of "yercum" gutta (*Calotropis*). Since then attempts have been made in the Punjab to produce these substances, and with some degree of success.

I should mention that gums are generically called in the Punjab "gond" or "chír" (Punjabí), or "simagh" (Arabic). Gum resins being all imported, and chiefly used in medicine, are called by their specific names only. Resins are generally called "rál."

I. GUMS.

1567.—Gum arabic (*Acacia arabica*). *Vern.*—Gond kíkar; simagh 'arabi; bábul gond.

This gum is produced from several species of *Acacia*—the *A. arabica*, the *A. farnesiana* (Vachellia), and the *A. vera* (the scented blossomed small *Acacia*, distinguished from the others by not having moniliform but roughly cylindrical pods). The "gond phulahí," or gum from *Acacia modesta*, is very similar.

The samples of gum exhibited vary from pure white to pale yellow, amber color, and reddish amber. The sample of *A. arabica*, &c., sent from the Madras Presidency is darker than any we have ever seen in the Punjab.

In Jálandhar a good *Acacia* yields a seer of gum annually for the first three years or so, but the tree dries up as it grows older. Specimens of "kíkar" or "babúl" gum, were sent from—

(4049) Delhi.
(4057) Hissar.
(4052) Gurgaon.
(4059) Sirsa.

"Bábul" and "kíkar" gums were distinguished in this latter district—the 1st being from the *A. arabica*; the 2nd, from the "choti kíkar" (*Vachellia*

* URE'S "Chemical Dictionary of the Arts."

farnesiana); it is gathered in March and April, and is exported from Sirsa eastward: it is much used for sweetmeats.

(4058) Rohtak (bábul).
(4061) Ambálah.
(4065) Jálandhar.
(4071) Kangra.
(4093) Amritsar.
(4113) Lahore.
(4138) Gujrát.
(4148) Jhilam.
(4150) Shahpúr.
(4154) Gugaira.
(4157) Muzaffargarh (bábul dá chír).

Price, 2¾ seers per rupee (*V. farnesiana* or *A. vera*); also "kíkar dá" at 2 seers per rupee.

(4170) Peshawur, from Kábul and Hindustán, and the Punjab; sells at Rs. 10 a maund.
(4172) Kapúrthalla.
(4174) Pattiala.
(4167) Dera Ghází Khán.

1568.—[4070]. "Pipalla gond" (*botanic name?*)

A red gum. Said to be obtained from the "kíkar," and used in making red ink. Exhibited from Kangra but not produced there.

Gum arabic is often mixed with other gums, as "siris," "phúllá," &c.; it varies in color, some being pure and other being colored red, from the astringent principle of the tree bark. The different colored gums are separately prescribed by native doctors—the red is said to be a remedy for coughs. Arabic gum is given to women at childbirth as a tonic. (As to color and degree of solubility, *see* Report of Jury). Some of the globules of gum are extremely friable, others not: this is said to be due to rain having fallen on them after exudation, and their subsequently drying in the sun.

1569.—Gond-i-phúláh (*Acacia modesta*).

This tree is abundant in Hushyarpúr.

(4078) Hushyarpúr.
(4122) Lahore.
(4139) Gujrát.
(4146) Jhilam.
(4150) Shahpúr.

1570.—Gond bhímbrí.

Is a gum yielded by the same tree as the last, but coming (it is said) from "Bhímbar," where these trees are abundant.

(4217) Lahore.
(4039) Amritsar.

1571.—Gond-i-siris, or chír siríń dá (*A. sirissa*).

A coarse gum, used for adulterating gum-arabic, and used under the name of "lera," in the art of printing calicoes with gold and silver leaf patterns. It is not soluble completely, like "gond 'arabi," but forms a stiff kind of jelly. Specimens appear from—

(4061) Ambálah.
(4068) Kangra.
(4152) Shahpúr.
(4160) Muzaffargarh.

Price, 2 seers per rupee.

1572.—[4050]. Khair-ka-gond (*Acacia catechu*). Gurgaon, Mewatti hills, and elsewhere.

A sample is also sent from Hissar, into which district it is imported from the neighbouring territory, and sells at Rs. 2 per maund.

A whitish gum, like arabic, which exudes from the bark when wounded: must not be confused with the "kath," or extract of catechu. (*See* Tanning Substances).

1573.—[4067]. Gond-i-dhao. Kangra district.

A transparent soluble whitish gum of *Cenocarpus latifolius*. This is found in several places in the hills, and yields a useful gum. A specimen was sent down for Nimar, on the Beás valley, where it is abundant.

1574.—[4066]. Kaimal, or kahmal gond. Kangra and Haripúr.

Used in calico printing. A dirty concrete, granular, brownish-black substance, that hardly looks like a gum—quite unlike the following. *Query*, perhaps this is a *gall* or excrescence from the bark of *Bombax heptaphyllum?*

1575.—[4077]. Kaimal gond (*Odina wodier*), from Hushyarpúr.

This has been evidently dissolved and then allowed to evaporate and coagulate again. The gum is in the form of a thick cylinder, with a bore or hollow in the middle; it is a pale stone colored gum, quite soluble, and unlike any other sample, it is described on the box lid as used to mix with chunam and whitewash.

1576.—[4143]. Kamala, or kemal, or kambal gum (*Odina wodier*). Jhilam.

The same as the above (brownish color and soluble, but not completely). Used in medicine for preparing plaisters.

1577.—[4090]. Gond-i-alúcha. Plum-tree gum (*Prunus alucha*), from Amritsar bazar. Local Committee.

1578.—[4123]. Gond-i-shaft-álú. Apricot tree gum (*Armeniaca vulgaris*). Lahore bazar.

An amber colored and soluble gum.

1579.—[4049]. Gond-i-darakht-i-ámb. Mango gum. Delhi.

A white gum, chiefly used medicinally. This is not the bitter strong tasting resin that is found in the fruit skin. This gum appears principally to be used down-country; the only sample in the 1864 Exhibition was from Delhi.

1580.—[4156]. Jhand ka gond. Jhand tree gum (*Prosopis spicigera*). Muzaffargarh. Local Committee.

Also (4166) Dera Gházi Khán. A sample of the same, called "kunda" in the local list.

1581.—[4165]. Chir-odheli, or vadhál. Dera Ghází Khán. (Hills).

In a vernacular account it is noted as coming from the "Bárkhán ki pahár." Obtained from the tamarisk (*T. furas or dioica*); said to be called "pinjwa" in other parts.

This occurs in nodules, highly friable, of a granular texture; the nodules appear opaque or a pale yellow; but the little grains of which the nodule consist are individually transparent, the centre of each nodule is more transparent and of a red color: its taste is very peculiar, of a bitter combined with sweet, like a mixture of liquorice, aloes, and sugar: it is quite soluble in water.

1582.—[4090]. Katíra gond (*Cochlospermum gossypium*). Amritsar bazar. Local Committee.

A sample is sent from Lahore (4126).

This is a semi-transparent white gum, in striated pieces, very much twisted and contorted; is a substitute for tragacanth. The tree occurs in the hills, is common in Garhwál and Kumaon, and grows also in Hindustán.

"Katira gond (*Cochlospermum gossypium, False tragacanth*). Samples are sent from Lahore and Amritsar. It grows at Hardwar, on the Sub-Himaláyan Hills, on the Hill Frontier of the N. W. Provinces, whence it is imported into the Punjab; it grows also in Southern India. It occurs in pieces, white, striated and twisted, and curled: it is used in the trade of shoe-making.

1583.—Jingan gum. Simla hills.

The white gum of *Odina wodier*, in stalactic white semi-transparent pieces, with little bits of bark intermingled. A sample of *Odina wodier* gum was sent from Madras, and is very dark colored and quite unlike this, being the dark variety.

1584.—"Sohájna" (sohanjna), gum of the *Hyperanthera moringa* (*Moringa pterygosperma*).

This is sometimes called "mochras;" in fact just as often as the sembal gum (*Bombax heptaphyllum*) is in the bazars. This gum varies in color from a red to a semi-opaque pink to almost white. The pink kinds are the most esteemed. It is used medicinally. Exhibited from—

(4046) Delhi.
(4069) Kangra district.
(4144) Jhilam. A very light colored sample, consisting of whitish pieces intermixed with pink.
(4155) Gugaira.
(4158) Muzaffargarh. Sells at 2¼ seers per rupee.
(4164) Dera Ghází Khán.
(4151) Shahpúr.
(4176) Pattiala.

1585.—Mochras or sembal gond (*Bombax heptaphyllum*).

(4076) Hushyarpúr.
(4145) Jhilam.
(4092) Amritsar.
(4120) Lahore.

This is a very highly astringent dark colored gum, much used in medicine by natives.

1586.—Mochras or phúl súpyárí (*Areca catechu*).

(4056) This is a specimen of that kind of *Mocharas*, which *looks* not unlike sembal gum, but is in reality not a gum at all, but a brown astringent gall blister, that is found on the *Areca catechu* palm. A sample is sent, called "saigata gond," from Gurgaon (4050). In my own collection there is a sample of this gum, which I got at Sealkot, called "mochras or phúl súpyárí" (flower of the areca), which last name, though "flower" is incorrect for a gall, yet indicates the origin. This is imported from Hindustán and Bengal, &c.; so that "mochras" has three meanings—1st, sohájna gum; 2nd, sembal gum; 3rd, areca galls.

1587.—Dhák gum or kamarkas (*Butea frondosa*).

A strong astringent gum, which exudes in red tears from the dhák tree. This might be produced in considerable abundance. There are in the Cis-Sutlej States (Kurnál and Thanesar) whole tracts of jungle

covered with the *Butea*. The dhák gum is supposed in native medicine to be highly tonic and aphrodisiac, hence its name "kamarkas;" it is a valuable tanning agent; it is used in European medicine, also being called "East Indian kino."

When fresh it is of a beautiful transparent red, in small sized fragments or grains; but when kept, it becomes opaque and darker in color.

It dissolves perfectly in water and partially in spirit. As a coloring matter it is strong and durable, but cannot easily be applied to tanning purposes. For an account of the properties of the gum, *see* Journ. Agri.-Hort. Soc. Bengal, Vol. V., p. 114, and VIII., p. 24, 1852; *see* also Journ. Roy. As. Soc., Lond., VII., p. 145. It is used in medicine as a powerful astringent, administered in the form of tincture and powder. Some specimens of this kino when analysed yielded 73½ per cent. of tannin. The natives in the North Western Provinces employ it for precipitating their indigo, and in tanning; but in England it is objected to on account of the discoloration it imparts to leather.

Samples were sent from—

(4047) Delhi.
(4053) Gurgaon.
(4091) Amritsar.
(4140) Gujrát.
(4147) Jhilam.
(4153) Shahpúr.
(4176) Pattiala.

As the earlier volumes of the Agri.-Hort. Society's Journal are now scarce, I extract some of the most useful passages from the paper in Vol. VIII. of the Transactions.

Tanning properties of the gum of the "dhák."—"With the view of making the information on the above subject more complete, we reprint from the 'Journal of the Royal Asiatic Society of Great Britain and Ireland,' the following paper, by PROFESSOR SOLLY, entitled, 'Experiments on the Dhák Gond, a natural exudation of the *Butea frondosa*.'

"This substance, which, although it differs in some particulars from the kino, which is found in the shops, yet as it agrees in its most important properties with what has so long been described under that name, it is most convenient to call it 'butea kino.'

"It is of a brilliant ruby red color, and transparent, and very brittle. It consists principally of small round tears, and other fragments, which from their form appear to have been detached from the lesser branches of the tree. When it has been kept for some time, it becomes opaque and dark colored; this, however, may be prevented, according to DR. ROXBURGH, by preserving it in well-closed bottles.

"When exposed to heat, the 'butea kino,' swells up, emits fumes which are partially inflammable, and then ignites; if after that it is removed from the source of heat, it continues to glow like tinder, until nearly wholly consumed, a very small portion of a white ash only remaining. Ten grains of the kino, carefully selected as to purity, were ignited in a covered platinum vessel, and retained at a red heat until all the carbonaceous matters were burnt; there then remained 0·45 grains of white ash, a very small portion of which was soluble in acids with effervescence, the remainder consisted principally of silica and alumina. The specimens of 'butea kino,' were far from being in a state of purity, being mingled with small fragments of wood, bark, and also with earthy impurities: these were evidently derived from the mode of collection, which most probably consisted in gathering from the ground under the trees the fragments of the natural exudations which had fallen from them.

"It swells and slowly dissolves in the mouth, having a pure, strong, astringent taste, like the finer kinds of catechu. It has no smell. In cold water it swells, and slowly imparts to it its fine red color; after some time, only the outer portions of the kino remain, which by exposure to the air had become dark-colored and almost insoluble in water, whilst the whole of the interior and unaltered kino is dissolved. These insoluble portions consist principally of difficultly soluble extractive. A sufficient quantity of boiling water dissolves the whole; and on slowly evaporating the solution, the difficultly soluble extractive separates in tough red films.

"Both alcohol and pyroligneous spirit dissolve a considerable portion of the 'butea kino,' but far less than water. Ether dissolves but little, and remains colorless; when a portion of ether is agitated with a strong aqueous solution, it soon becomes thick, and on evaporation, yields a considerable portion of tannin.

"A small quantity of persulphate of iron changes the color of the aqueous solution to a dirty green; in rather larger quantities occasions a copious green precipitate.

"A series of experiments were made on the effect, of various re-agents on solutions of this kino, with a view to ascertain which were the best precipitates of the red color, either for dyeing, or as a pigment.

"Solutions of most acids, and acid salts, changed the colors to a light orange, and for the most part occasioned copious precipitates; they were nearly all of a dirty yellow or orange color.

"When a few drops of a strong solution of caustic potassa were added to the aqueous solution of the kino, the color was immediately altered, and very much improved, becoming of the most splendid crimson; when, however, a little more of the solution of

potassa was added, the color rapidly became gray, and a copious precipitate fell. It very quickly became dark-reddish gray, and nearly the whole of the color was destroyed. Caustic soda, and ammonia likewise improved the color in the same way. When acids were added to solutions thus precipitated, so as just to neutralise the alkali, some of the precipitate redissolved, and the rest became orange. Carbonates of potassa and soda both very much deepened the color of the solution: it was however not to be compared in beauty of color with the solution obtained by the addition of a small quantity of caustic potassa, and had a slight brown tinge. In general, most saline solutions occasioned precipitates which were either pink, gray, or colors between the two. Acetate of lead, as well as several other metallic solutions, precipitated the whole of the coloring matter. The precipitate obtained by adding a solution of alum either to a neutral solution, or to one containing a small quantity of alkali, was of a dirty pink color. When gelatinous or recently precipitated alumina was agitated with any of the highly colored solutions, it soon abstracted all the coloring matter, but the lake so formed was, like those formed by precipitation, of a dingy color. The precipitates formed by metallic solutions were of very variable hues, but in no case were the colors so obtained decided or brilliant. Attempts were likewise made to fix the color in the fibre of cotton, silk, wool, &c., in various ways and with different mordants; the colors were all imperfect, dingy, and variable in color, but they were very permanent. This agrees with the results obtained by DR. ROXBURGH, but as his experiments were made on the fresh substance, they were under more favorable circumstances. The cause why the colors cannot be well employed is, that the red coloring matter is so intimately combined with the tannin and gum, that whenever the one is precipitated, it carries down the other also; and hence, when we endeavor to precipitate the tannin alone, the red color or extractive is always precipitated with it: and this, as will presently appear, is in some cases a great inconvenience.

"The solution, after the separation of the precipitate, contained gum, extractive, gallic acid, and minute portions of other matters: the quantity of gallic acid was very various, but in no case did it appear to exist in any considerable proportion.

"It was difficult to ascertain the exact per centage of tannin, as it varied very much in different specimens submitted to examination. I have therefore repeated the experiments on the several portions, and shall now give the mean of some of the best results obtained.

"From the large per centage of tannin which this substance contains, as indicated by the above experiments, and from its probable cheapness, it promises to be of considerable value in the arts, and especially in that of tanning leather. As a substitute for the astringent substance now in use, its adoption in many cases from convenience or economy are self-evident and require no comments; but in the art of tanning leather so many points require to be considered, that it is necessary to say a few words on that subject. On putting a piece of pelt of prepared skin into a strong solution, it soon absorbed a considerable quantity of tannin, but, at the same time, became of a rather dark color; this is, an unfortunate quality, because, as the consumers of leather judge of its quality in part from its color, the tanners do not like employing anything which deepens the color too much. The color taken up by the leather of course varied with the solution employed, a cold solution of the kino from MR. BECKETT, giving a much lighter colored leather than a hot-made solution; that from Bombay gave a darker color, and the solution was very subject to gelatinise and become turbid; this of course would be a great inconvenience. The leather tanned with this kino was very hard and rather brittle, but it was tanned with considerable rapidity. These results were obtained on small pieces of thin skin, and I do not anticipate that it will answer at all for tanning such skins; its richness in tannin however promises well for tanning thick hides; and the results of experiments on its application to this process, now in progress, will be communicated on a future occasion."

1588.—[ ]. Arjan gond, gum of *Terminalia arjuna.*

A gum found only with druggists: is of a clear golden brown color, and quite transparent.

II. GUM RESINS.

There are hardly any of them indigenous to the Punjab, but are imported from Persia and the countries bordering on the Persian Gulf, from Kábul and Afghánistán, or from Bombay, in which case they may be either the produce of the Persian Gulf or of the Southern Provinces of India and the Islands.

☞ The *medicinal* uses of these substances have already been given under the head "Drugs."

1589.—[4102]. Kundras, kundar. (*Boswellia thurifera*, Roxburgh; *B. serrata*). Amritsar bazar; also (4128) from Lahore.

This is same as the Indian Olibanum of the Coro-

mandel coast, Central India, Behár Hills (*Boswellia papyrifera*, and allied species), and resembles Arabian olibanum.

There are two other known species of Arabian *Boswellia* yielding "labán," or olibanum, distinguished by the name "yegaar," viz., "labán maïti;" "mohr add;" and "mohr madow;" which last is identified with HOCHSTETTER'S *B. papyrifera;* and there is also another unnamed species of DR. CARTER'S. CAPTAIN PLAYFAIR, Resident of Aden, says, "that there are several other species in Africa which he has not been able to obtain."

Boswellia thurifera grows to a large size in hilly situations, from the coast of Coromandel to Central India. * * * * * * * Indian Olibanum, which is now the most esteemed, is in roundish or oblong tears, of a reddish or light yellow color, usually covered with whitish powder, from the attrition of the pieces one against the other, translucent within, having a warm bitterish taste, and having a balsamic odor, especially when warmed or burned. Specific gravity, 1·22. When analyzed by DOCTOR O'SHAUGHNESSY, a fine specimen gave—of resin, 37 parts; volatile oil, 28 parts; gum, 4; gluten, 11; in 100 parts: but the quantity of volatile oil is much less when olibanum has been exposed to the air and the resin becomes dry; which is the state it is usually seen in commerce. BRACANNOT obtained only 5 per cent. of volatile oil; of resin, 56; gum, 30; substance like gum, 5·2; loss, 0·8 = 100.

The African or Arabian olibanum is in yellowish tears, and irregular reddish lumps or fragments.* The tears are generally ovoid, oblong or rounded, not very brittle, with a dull and waxy fracture, softening in the mouth and bearing much resemblance to mastic, from which, however, they differ in their want of transparency. The reddish masses soften in the hand, have a stronger smell and taste than the tears. Both LIEUT. WELLSTED and MR. JOHNSTON state, that large quantities of olibanum are exported from the Somauli coast.

African Olibanum, known on the continent as *Encens d' Afrique* and *Africanischer Weihrauch*, is imported into Venice and Marseilles from Suez, being obtained from Arabia and the east coast of Africa. DR. PEREIRA, who mentions it as African or Arabian olibanum, describes it as being in smaller tears than the Indian variety, yellowish or reddish, and intermixed with crystals of carbonate of lime. DR. MALCOLMSON writes to me from Aden, that large quantities of Olibanum are produced in Africa, principally on the high and extensive range of limestone hills of the Somauli coast, which are in the vicinity of Capo Guardafui. CAPTAIN KEMPTHORNE, of the Indian navy, describes the tree which produces frankincense on these hills, at about 1000 feet of elevation in the neighbourhood of Bunder Maryah, and that the olibanum is carried to the Arabian shore by boats from Maculla. "The tree attains a height of about 40 feet, firmly attached to the bare limestone rock, by a thick mass of vegetable substance (part of the tree), which sends roots in the crevices of the rock to an immense depth."—*Malcolmson.* "CAPTAIN K. describes the bark as consisting of four different layers. The outermost of all is very thin, and similar to that of the beech. The two next are of a singularly fine texture, resembling oiled letter-paper, perfectly transparent, and of a beautiful amber color. It is used by the Somaulis to write upon. The inner bark of all is about an inch thick, of a dull reddish hue, tough, and not unlike leather, but yielding a strong aromatic perfume. The wood is soft and white. By making a deep incision into the inner rind, the gum exudes profusely, of the color and consistence of milk, but hardening into a mass by exposure to the atmosphere." By this bark, of which he received a specimen from MAJOR HARRIS, MR. BENNETT, of the British Museum, has been able to identify it as being very similar to that of a tree, of which specimens were collected by SCHIMPER in his Abyssinian journey, on the mountains below Dacheladschezanne. It flowers in December, and ripens its fruit in April. Of this the Abyssinian name is stated to be *makker*. It has been named *Plösslea floribunda* by ENDLICHER, in *Nov. Stirp. Mus. Vindob., Decad.*, No. 47, and figured in *Iconogr.* t. 129, 130. He has attached it in his *Genera Plantarum*, p. 1073, as an anomalous genus to *Sapindaceæ*.*

This gum resin is called (Olibanum) *quasi* Oleum libani, called in Arabic "labbán" and "alk-ul labán," (not "lubán," which is the Urdu for "styrax" gum Benjamin). DR. CARTER mentions an Arabic writer, IBN BATUTA, who calls this gum "alkundaru." The Indian olibanum, is called "ganda barosa," and "salai" (Beng.) This is supposed to be the frankincense of the ancients, and is still used in Roman Catholic churches for incense. When powdered and burnt on charcoal it gives off whitish fumes and a very agreeable odor; to the taste it is aromatic, not so bitter as myrrh (bol), but having a flavor that reminds one of cheese.

* All this is taken from a Paper by DR. ROYLE on Olibanum.

* Since this paper was written, the genus *Plosslea* has been abandoned, and the African trees fully admitted to be *Boswellias*. This was anticipated by DR. ROYLE, both in the paper from which this extract is taken, and also in his "Illustrations of Himalayan Botany," at p. 177.

The tree producing this gum resin, *B. thurifera* (*Terebinthaceæ*) is said to grow on the mountains of the Coromandel coast, and in Central India.

The "Makhzan-ul-adwiyah" says, that "kundar" comes from Yaman, and the U'mán daryá (shores of the Gulf of Ormus), thus acknowledging only the Arabian olibanum. As our Punjab olibanum comes from Bombay, it is most probably this kind we get, and not the Coromandel olibanum.

BIRDWOOD gives as its habitat Arabia and the Troglodyte country. It comes to the Punjab by Bombay principally; but may also come overland by Herat and Mashhad.

In the "Technologist" for July 1864* "elk-al-labán" (olibanum), is mentioned as being sold in the bazars of Bághdad at 10*d.* to 1*s.* per lb., and the writer says, that it is imported from Kurdistán. DR. BIRDWOOD† quotes MR. VAUGHAN, who enumerates the species of "labán" collected by the various tribes of Somáli Arabs, and found in the Aden market. They are "labán maiti," from Bandar Mait; "labán nánkar," from Bandar Aungure, and the country of Door Muhammad. These are brought by the Abardagahala Sumális; "labán barbara or masliká," is brought by the Ayal Yunus and Ayal Hamid Sumális; "labán makur," from several places in the Warsangli and Mijrthín Somális, about Cape Gardafui. Some of this finds its way to Bombay; but the commonest kind brought to Bombay is the "Arabian olibanum" which, writes BIRDWOOD, is exported from the ports of the Hadramaut (a province of Arabia Felix) in enormous quantities to Bombay, and thence shipped to all parts of the world.

CARTER, as quoted by DR. BIRDWOOD, writing of the Arabian "labán" district, says: "Coming from the N.E. we first met with the frankincense trees, on the Sabban mountains, in latitude 17° 30′, N., and longitude 55° 23′, E., where the desert ends, and the wooded mountainous region begins, and following the coast, which runs south-west, we found the frankincense exported from the different towns gradually diminishing after the bay of Alk'ammar until we arrive at Makalla, from whence none is exported from the interior of Arabia."

With regard to Indian olibanum, which is the produce of *Boswellia thurifera*, which COLEBROOKE called *Libanus thurifera*. COLEBROOKE positively indentifies this with the costly frankincense of the ancients; but Arabia Felix is a much more likely source for that than the coast of Coromandel. BIRDWOOD quotes Belgaum also as its habitat, but I do not find Behár noted, though DR. HOOKER* describes the plant thus in the Behár hills: "We continued to ascend to 1,360 feet, where I came where a small forest of the Indian olibanum (*B. thurifera*), conspicuous from its pale bark and spreading curved branches, leafy at their tips: its general appearance is a good deal like that of the mountain ash. The gum, celebrated throughout the East, was flowing abundantly from the trunk, very fragrant and transparent."

It was formerly believed that this olibanum was yielded by a juniper, but as the article in question is a *gum* resin, it cannot be yielded by a juniper (*Coniferæ* only yield true resins). But no doubt, as BIRDWOOD remarks, some of the European frankincense is the product of a juniper, and that the common frankincense is a resin derived from the *Abies excelsa*.

In America there is a pine called the frankincense pine. It is remarkable also that the name "gandhabaroza" is given as a synonym for this olibanum (which, though it is not much used I believe in Upper India, is no doubt in use in other parts. "Gandafaroza" is the native name given to *B. thurifera* in the Madras Jury Report on Gums, 1857, 9·0); and "gauda-baroza" is a common name for the unctuous turpentine exuding from the *Pinus longifolia* of the Himálayas. DR. ROYLE† also writes, that in Kanáwar, *Juniperus religiosa* or *J. recurva*, is called "gogal" (the name applied to produce of *Amyris*, and the resin burnt as incense, which fact again brings the *Conifers* and the *Balsamodendrons* together.

COLEBROOKE has written about the Coromandel olibanum in the Asiatic Researches, Vol. IX., p. 377. Olibanum contained on analysis of 100 parts,

Volatile oil, ...	8·0
Resin, ...	56·0
Gum, ...	30·0
A gum like substance insoluble in water and alcohol, ...	5·2
Total, ..	99·2

This "kundras" readily dissolves in spirit, forming a flocculent milky liquid.

A sample called "kundar" or "kundal" from Amritsar was unlike the above, being of a very dark brown, but clear, and without much admixture of foreign substances. It crushes like a resin into a whitish powder, burns with a somewhat pleasant smell, but not so strongly fragrant as the Arabian olibanum,

* "The Technologist," July 1864, p. 541.
† "Economic Products of Bombay," p. 24.

* "Travels in the Himalayas," Vol. I., p. 29.
† "ROYLE'S Illustrations," p. 351.

and it has not the peculiar taste that the Arabian frankincense has. This species may be the produce of *B. glabra.*

DR. F. WATSON describes* "kundar" as covered with a "white bloom:" this is only that the surface of the pieces rubbing together partly scarifies the surface into the white powder that all solid resins can be reduced to on pounding or grinding.

1590.—[4135]. "Bol," myrrh. Lahore bazar. RAM SING, Druggist.

Produced by *Balsamodendron myrrha (Nees; Von Esen.)*, (N. Ord. *Amyridaceæ*). It grows in Arabia, where there is also an inferior kind, called "baisa bol;" or "hebbakhade" by the Súmalis. DR. BIRDWOOD mentions that inferior myrrh, in Bombay, is called "baisa bol." I suspect that this sample is "baisa bol." Since writing this I have obtained two samples of "bol" from the bazar, both are perhaps from a *Boswellia*, but certainly different *species*; one, the 1st quality, being a dark reddish brown, like "gúgal;" the other (inferior "bol") a pale yellowish color with the whitish dust outside, resulting from the rubbing together of the pieces in carriage.

The sample I describe from is a gum resin having a texture like "kundras," but of a clear pale brown color, with the same whitish powder on the pieces, it might be mistaken for a dull colored specimen of "kundras." It is very bitter to the taste, and on being burnt yields a pleasant odor, but not very powerful. This is exclusively imported from Bombay, whence it comes from Arabia. PLINY says, that in his time there were six different kinds of myrrh which grew in Arabia: he says myrrh was often adulterated with mastic. The proportions of gum and resin in this substance, are, according to DR. THOMSON, 34·68 gum, 66·32 resin.

In a list of Baghdád drugs, before alluded to, myrrh is noticed as coming from Mekkah.

1591.—[4095]. Gúgal. Amritsar bazar.

(4125) Lahore.

(4169) Dera Ghází Khán.

This is called Indian Bdellium; its synonyms are given as "mukal" (Arabic); "raughan turb" and "aflatún." In Syrian, the "Makhzan-ul-adwyia" says, it is called "badlíyún," which is like a corruption of *βδελλιον*, Bdellium.

This is sometimes mixed at Bombay with myrrh.

The "gúgal" is the produce of *Balsamodendron Roxburghii*; (*Balsamodendron Mukal*; Roxburgh), *Amyris agallocha*, *Amyris commiphora*, and allied species. (This is unlike the resin of *Boswellia glabra*, called on the Telugu coasts, "gúgulá").

DR. ROXBURGH says, that the *Balsamodendron* is found in Assam and Silhet, and districts to N. and W. E. of Bengal.*

It is certainly common in the Sulaimaní hills, on the Punjab West Frontier,† in the Sindh Forest Report for 1862-63, I find that a tree is mentioned as abundant in the Soorjani hills, called "bye" (*sic. in original*), which is said to be a *Balsamodendron.*

"Gúgal," is also mentioned by LIEUT. CARLESS, in his account of Kuráchí, as coming from Las, in the province of Beíla, to the north of Khelat.‡

"Gúgal" is also brought into the district of Dera Ghází Khán, to the amount of 300 maunds a year, by the lower passes of the Dera Ismaíl Khán district and the Sanghar pass.§ It sells in the Dera Ghází Khán district for 2 seers to the rupee.

The samples are of a somewhat soft and not brittle texture, golden brown, but outside dull and darker color. The taste is a peculiar aromatic earthy taste, quite unlike the bitter of the foregoing species. It burns readily with a slight but pleasant smell.

There can be little doubt that the hills of Bilúchistán, and still further, are the source of "gúgal" imported into the Punjab.

The "Makhzan-ul-adwiya," localizes "gúgal" to Daryá Umán (Gulf of Ormus), and Shanjár (a province of Arabia Felix), and says, it is found in Hindustán, which is likely true enough.

1592.—[4119]. Jaushír, or gaushír. Lahore bazar; also from Amritsar (4097).

Gum opoponax (*Pastinaca opoponax*), *Opoponax chironum* (Nat. Ord., Umbelliferæ), has its habitat on the shores of the Levant and Asia Minor.

This is one of the less known gum resins, exuding from *Umbelliferous* plants. From the appearance we would class it with "ushak" (*Ammoniacum*) and assafœtida.

Two samples of the gum are before me—one, the best, in small rounded tears, is whitish yellow inside, and a decided yellow outside; it has a texture almost like wax—indeed wax is used to adulterate it—it softens to heat, and burns not very readily, with a peculiar smell.

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* Indian Catalogue International Exhibition of 1862. Class V., p. 108.

* ROYLE'S Illustrations, p. 177.

† Sind Forest Report in M.S. among Records Financial Office. "Forests."

‡ Bombay Selections. Sindh. XVII., p. 202.

§ POLLOCK'S Report, Punjab Corespondence, Vol. IV., Part 4, p. 64.

It has a peculiar and very bitter taste, which suggests to me that it was once a liquid milk coming from some nitrogenous plant or root. The smell is similar to "ushak," but not so strong or disagreeable. The inferior quality is in large pieces, as if it were a residue or second extract, having the same general qualities, but a dirty whitish color, and a dirty brownish color outside.

When dissolved in spirits it becomes like milk, which it also does when ground up in a pestle and mortar with water (in which way it is given by native doctors as a medicine) : it is to this peculiarity, no doubt, that this name of "gaushír" (cow's milk) is due. It is also, I believe, given with vinegar, in which it is completely soluble, forming a thick milky liquid. "Gaushír" from the absence of the letter "g" in Arabic, has been turned into "jau shír"; this shows, I think, that it had its origin in a Persian speaking country, as its original name is Persian. The "Makhzan-ul-adwiya" confirms this, and observes that it comes from a village called Máh, near Ispahán, where also "sakbínaj" is produced.

It gives also a name of "jáhoshí" at Shiráz ("hoshí" is the name by which DR. LINDLEY obtained it at Bilúchistán—the fact is remarkable).

ROYLE says that "jawashír" is imported into India from Arabia, and into England from Asia Minor. He says that DR. LINDLEY had some seeds sent from the hills of Bilúchistán, which were called "háshí," and were then considered to be the *Opoponax*.*

The "Makhzan" describes the plant as "having abundance of close set stalks, somewhat tall, and covered with a white down. Its leaves are described as like those of the fig tree. The flower head, 'kubah,' is like that of the 'shibt' (*Anethum sowa*), the flowers being yellow and scented. The seeds are black like anise, and have an aromatic smell (tánd)."

The author goes on to state that the gum is obtained by taking up the root at the time when the plant begins to sprout, and breaking it open, and allowing the juice that exudes to concrete on leaves placed below.

An inferior kind, he adds, is made by mixing up wax and ammoniacum by way of adulteration with a little of this gum.

From this it is clear that the plant is *Umbelliferous*.

DR. ROYLE does not give any authority for the statement that *Opoponax* comes from Arabia, and I am quite unable to discern any evidence in support of the statement.

"Jawashír" occurs in the bazars of Baghdád (it sells for 10½*d.* per lb.), and is imported from Persia, which confirms the statement in the "Makhzan-ul-adwiya."*

LINDLEY† says also that *Opoponax* is the concrete juice of *Opponax chironum*, inhabiting the Levant. I believe that the origin of the Punjab druggists' "jaushír" is Persian, and the countries to the south as far as Bilúchistán. The Persian origin of the names and the coincidence of the Bilúchistán name, and the Shirazi names, "háshí" and "jahúshi," are confirmatory of the supposition.

In Lahore the gum sells at 6 annas a seer. At Amritsar I recently obtained a sample, which the owner assured me had come direct from Bushire, and was of superior quality. It was in quite small tear-like pieces of a dark tawny reddish yellow outside, and whitish inside; being much smaller and darker than the ordinary samples.

1593.—[4096]. Sakbínaj. (*Sagapenum* of drug-writers.) Amritsar bazar; also Lahore (4106).

Value, Rs. 5 a seer.

Named *Ferula persica* (W.); in Hindi, "kundal" (not to be confused with "kundar" *olibanum*) ; but the plant from which it is derived is quite uncertain.

DIOSCORIDES, iii. 95, says, it is produced by a "ferula" growing in Media. AINSLIE‡ quotes DALE and MILLER, who say that it is brought to England from Alexandria.

The "Makhzan-ul-adwiya" says, it is found near Ispahan, at a village called Máh.

It is extremely difficult to obtain, and very costly. With great difficulty I obtained a small piece for Rs. 2, from PANDIT HIRANAND, who was a companion of DINA NATH, and had travelled much in Khorásán and Bukhára. The piece is very like "ushak," with a white waxy appearance and yellow outside, part of which had been removed.

The druggists if asked for "sakbínaj," as none of them have the real drug, produce "jaushír," or "ammoniacum."

It is supposed to be both antiseptic and alternative in medicine ; it is still used in European medicine, being an antispasmodic and emmenagogue. The proportions of gum and resin are given by AINSLIE. Resin, 54 ; gum, 31 ; and 12 of volatile oil.

The sample (4096) exhibited as "sakbínaj," from Amritsar, was evidently not "sakbínaj," but a dark massive gum resin, full of little sticks and impurities ; which, when broken exhibited when it powdered in

* ROYLE'S Illustrations, p. 231.

* "Technologist," July 1864, p. 542.
† Veg. King., p 776.
‡ Mat. Med. I., p., 358.

breaking, a green color; it had a bitter taste, and a somewhat alliaceous smell when broken.

1594.—[4105]. Bárzad (barija) *Galbanum.* Lahore druggists.

The sample actually exhibited under 4105, proved not to be the *Galbanum*, but I have, nevertheless, included the name and number, as the real gum *Galbanum* is used in native medicine; but it is rare and scarcely anything is known of it.

It is referred to *Ophoidia galbanifera* (Don), and *Galbanum officinale* (Don). In the "Alfáz" and "Makhzan-ul-adwiya," "kinnah" and "nafil" are given as the Arabic names; and "kalbániya" (χαλβανη); as the "yunání" or Greek name; the Turkish, "kási." The author adds, that the Dictionaries give "ganda bihroza:" and by this latter name it is known. This proves that the real drug is almost unknown: "ganda bihroza" is quite different, but always sold for "barzád."

There appears to be two kinds of *Galbanum*—Levant and Persian. The Persian, which is the one which comes to India, is yielded by *Ophoidia galbanifera*. The specimens above quoted are not the real "barzád," which I have been utterly unable to obtain. Whenever I asked for "bárzad" and "barija," I invariably got a pot full of the semifluid sticky whitish "ganda baroza," or crude turpentine of the *Pinus longifolia*. "Bárzad" was also sent me of three qualities, which were also as far from the real article as the last-mentioned; the 1st has a clear transparent yellow resin, the transparent yellow passing occasionally into a semi-opapue cloudiness, and occasionally into spots of darker colored brown yellow. I do not think it is a pine resin; but probably a *Shorea* or *Vatica* resin. The author describes the plant yielding this gum resin, as similar to that producing "sakbinaj," and with leaves like the "chinár:" one kind of this gum is yellowish white, and another reddish yellow, and of considerable weight, which latter is the best. The author adds, that the specimens known have been obtained from a "conifer" as big as a cypress, and like the "dahoni balsán" *(Balsam of Gilead)*, and says that it is called "labání" deodar; and then goes on to describe the common pine resins, which are always sold in druggists' shops in lieu of the real drug. That given as 2nd quality was a piece of clear resin, slightly wrinkled on the outside, and of a olive green color; when a piece was broken off, might easily have been mistaken by its fracture and transparency, for a piece of bottle glass. By its smell it is evidently a purified pine resin of some kind. 3rd piece, called "bárzad" third quality, is a piece of common impure black pine resin, or "colophony."

1595. [4121]. Ammoniacum, "'ushak." Lahore druggists. A sample also from Amritsar (4094).

This is the last of that series of Umbelliferous gum resins, *Opoponax*, *Galbanum*, *Sagapenum* and *Ammoniacum*, that resemble each other so much in their texture, smell and color. The gum is yielded by *Dorema ammoniacum*.

'Usbak has an amygdaloid structure, like a series of tears of the gum agglutinated together: it yields to the nail like wax, softens to heat, and if pulled apart draws slightly into threads; inside it is waxen white, outside brownish yellow. It has a slight nitrogenous vegetable smell, but when a little bit is taken between the finger and thumb, and rubbed and heated, it gives out a pungent and highly disagreeable odour, suggestive of its vegetable origin. This is the least valuable of these series, being priced at Rs. 2 per seer, while "jaushír" is Rs. 10; for this reason it is used to adulterate and counterfeit the others.

1596. [1926]. Assafœtida. Lahore bazar. And root of the *Narthex assafœtida*, dug up at Pangi, in the Chenáb valley, the most southern locality in which it has yet been found.

Narthex assafœtida. This is called "hing" in Hindí; "angúzah" in Persian; "hiltít" in Arabic; "anjadán" is also given as a synonym (AINSLIE, I., 21); and "samagh-ul-mahrús" (gum of the mehrus root) in the "Alfáz adwyia." "Juwífeh" (Arabic) is a name given in the bazar of Baghdád.*

The "Makzan-ul-adwiya" gives "anghozah," or "angazad;" or in Ispahán dialect, "aukasht kundah."

Its botanical synonyms are *Ferula assafœtida* (L.), and *Ferula persica* is also given as a source of assafœtida (Lindley, V. K.)

BIRDWOOD says, that the botany of this plant "is not yet properly determined, for although *Narthex assafœtida* certainly yields the drug of commerce, a portion is probably contributed by other Umbelliferous plants.†

Assafœtida is the type of the Umbelliferous gum resins, at the end of which series I have placed it. DR. LINDLEY remarks:‡ "All the Umbelliferous plants appear to form secretions, in which there are three different principles.

1st. Some of them yields a watery acid matter from their roots, rendering them quite poisonous.

2nd. Some of them have milky secretions, consist-

*"Technologist" for July, 1864, p. 542, where it is added that the gum is sold for 7*d.* per. lb. troy, and comes from Persia.

† "Economic Products of Bombay," p. 42.

‡ Veg. King., p. 775. *See* also ROYLE'S Illus., 231.

ing of mucilage and essential oil, which hardens into a gum resin ; and,

3rd. Is when the plant has a peculiar aromatic oil, in which case it becomes carminative in effect, and has aromatic qualities, such as dill, anise, carraway, and coriander ; when all three principles are absent and merely mucilage and sugar are found in the root, they are nutritious as food, *e. g.*, carrot, parsnip, &c.

AINSLIE* quotes CAPT. MACDONALD KINNEIR, who states, that assafœtida is a staple article of export from Herát, in Khurasán ; he says, that the leaves are used as a vegetable, and the root is also roasted.

The gum is obtained from the root when the plant is four years old.

The following account is extracted from an account by DR. BELLEW (Guides Corps), of assafœtida as seen by him on his journey to Kandahár. This extract will be found in Appendix VII. of MR. DAVIES' Report.

"The frail vaginated stem, or the lower clusters of sheathing leaves, the former belonging to old plants and the latter to young ones, is removed at its junction with the root, around which is dug a small trench, about six inches wide and as many deep.

"Three or four incisions are then made around the head of the root, and fresh ones are repeated at intervals of three or four days ; the sap continuing to exude for a week or fortnight, according to the calibre of the root. In all cases, as soon as the incisions are made, the root head is covered over with a thick bundle of dried herbs or loose stones, as a protection against the sun ; where this is not done the root withers in the first day, and little or no juice exudes.

"The quantity of assafœtida obtained from each root varies from a few ounces to a couple of pounds' weight, according to the size of the roots, some being no bigger than a carrot, whilst others attain the thickness of a man's leg. The quality of the gum differs much, and it is always adulterated on the spot by the collectors before it enters the market. The extent of adulteration varies from one-fifth to one-third, and wheat or barley flour, or powdered gypsum, are the usual adulterants. The best sort, however, which is obtained solely from the node or leaf-bud in the centre of the root head of the newly sprouting plant, is never adulterated, and sells at a much higher price than the other kinds. The price of the pure drug at Kandáhar varies from four to seven Indian rupees per "man-i-tabríz" (about three pounds); and of the inferior kinds, from one and-a-half to three-and-a-half Indian rupees per "man." The assafœtida is commonly used by the Mahommedan population of India as a condiment in several of their dishes, and especially mixed with "dál." It is not an article of general consumption in Affghánistán, though often prescribed as a warm remedy for cold diseases by the native physicians, who also use it as a vermifuge.

"The fresh leaves of the plant, which have the same peculiar stench as its secretion when cooked, are commonly used as an article of diet by those near whose abodes it grows. And the white inner part of the stem of the full grown plant, which reaches the stature of a man, is considered a delicacy when roasted, and flavored with salt and butter."

DR. BELLEW, in another communication says, "that there are two sorts of assafœtida—that which occurs 'in tears,' is the gum that exudes, drop by drop, from incisions made in the top of the root. The lump assafœtida is that which exudes when the root is sliced across, and the juice coagulates." DR. BELLEW adds, "that there several Umbelliferous plants, especially on the slopes of the 'Safaid Koh,' which exude a milky juice, but which is not collected." Certainly the lump sort is the commonest in the bazars. I have found thin slices of the root mixed with samples of the gum. Assafœtida was brought to me of two colors—one a dirty pale brown, the other with a red or salmon-color ; but both similar in texture.

There is a variety of assafœtida, called "stony assafœtida," on account of its containing fragments of gypsum, about 50 per cent.; this may be caused by the gum being allowed to drop on the ground of the hill side, where gypsum occurs, and then the whole scraped up together, gum, earth, and all. In the Great Exhibition of 1851, there was an assafœtida unlike others, of a brown colored pellucid appearance, full of bits of stalks. This renders the supposition probable that assafœtida is produced by more species than one.

The "Makhzan-ul-adwiya" enumerates two kinds—one called "tíb," and one "munattan."

Tíb is white assafœtida ; called also "kolahpar."

"Munattan" is dark assafœdita; called in Persian "kamát."

The former is the best kind. The author adds that assafœtida grows at Herát.

There is no doubt that assafœtida is produced in Khurásán and the Southern Provinces of Persia, and in Bukhárá and in Bilúchistán;* as also at Pangi, in the Chandrabhága valley, and other places in the hills of the Punjab, &c.

This last locality, which is the most Southern habitat yet known for the drug, has been established beyond a doubt, by the large root brought down by DR. CLEGHORN, and now in the Lahore Museum ;

* Mat. Medica, I., 21.

* Bombay Selections, XVII.

the root is thick and fleshy, and after growing downwards in one piece, branches of into a number of fleshy tubers, and then again into others, like a large tooth with many roots. On being cut, it gives the unmistakeable smell. MACCULLOCH* says, it grows in Sindh, but this I believe is without foundation, and the idea is derived from the fact that assafœtida will be found in quantities at Shikarpúr and Hydrabad in Sindh, but then it is brought thence from the North of Kabúl and Bukhára provinces.

In India, assafœtida is chiefly obtained overland by the Bolan pass, and by the Peshawur passes, but large quantities are shipped from various parts of the Persian Gulf, and are thence taken to Bombay for export to Europe: the smell is so offensive, that sometimes ships are exclusively employed in the Persian Gulf to carry this gum.

It would have been hardly necessary for me to allude to the celebrated "asadulcis," except that PEREIRA has mentioned the two together.

This "asadulcis" or "laser" (*Laser cyrenaicum*) was the produce of a plant *Thapsia sylphium*. In ancient Cyrene, so sovereign were its virtues supposed, that the figure of a plant corresponding to the *Thapsia* was wrought upon several Cyrenaic and Barcæan coins; and BIRDWOOD mentions, that there is an antique vase extant, having a representation of King Arcesilaus weighing out the drug for sale. PEREIRA quotes AVICENNA, who says, there are two kinds of "asa," one sweet, the other fœtid (*Asa dulcis* and *A. fœtida*). The Cyrenaic "laser" was soon exhausted, not obtainable even in the time of PLINY.

1597.—[4136]. Farfeyún, gum of *Euphorbia*. Lahore bazar; also from Amritsar (4099).

This is given by BIRDWOOD as *Euphorbia canariensis*: its Persian name is "shír-i-dirakht-i-zakúm," and Arabic, "akal nafsah." The *Euphorbium* known in Europe is very likely the juice of *G canariensis*; but I have no doubt that the *Euphorbium* of the bazars is produced from *E. antiquorum* and other species. It is a remedy for rheumatism. AINSLIE says, it is prepared by boiling with sesamum oil, but the exhibited samples appear to be the plain coagulated and dried juice. The "Makhzan-ul-adwiya" says, it dissolves easily in water and in olive oil.

The "Makhzan-ul-adwiya" says, that "farfeyún" comes from the cities of Barbar and Rahíl, so the gum gets called "Barbariya" (perhaps he means North Africa. King JUBA, of Mauritania, is said to have discovered the juice, and called it after his physician, EUPHORBUS). It is the gum of a tree called "fafkah" but the "Makhzan" says, that the plants yielding this are two—one with lettuce-shaped fleshy leaves, full of milk and bearing thorns (cactus species ?); the other kind of plant has dark colored leaves (siya), and spreads on the ground; it also has sharp thorns.*

To the natives generally no other use of *Euphorbia* juice is known, but that of a medicinal gum, but lately several papers have been communicated to the Agri.-Horticultural Society of the Punjab, as to some further uses. I append an extract from the Proceedings:—

The following letter (dated Jummoo, 2nd December) from F. DREW, ESQ., was read regarding a gutta-percha-like substance derivable from various indigenous plants.

"In answer to your note, I forward by bangy-dák, four specimens of the substance to which, I think, MR. COOPER must have referred. You will better than myself be able to say what name it should be called by. It is MR. RATH, Mechanical Engineer to the Maharajah, who has made the experiments, which have resulted in the production of this, which he says is of considerable use to him for various purposes connected with machinery.

"It is procured by boiling down the milky juice of the common cactus, which here abounds in hedges and on the lower hills; after having brought it by this means to the consistency required (which may vary according to the use it will be put to) it can be purified by adding dates (? *sic.*) and boiling this away, taking off the scum as it rises; then by pouring cold water on it will so far solidify that it may be easily taken out of the vessel.

"MR. RATH has also prepared similar stuff from

* Commercial Dictionary. Art.—Assafœtida. The article is so important that I quote from it to illustrate the commerce of this article. "It is imported packed in mats, casks and cases, the latter being in general the best. It should be chosen clean, fresh, strong scented, and of a pale reddish color, variegated into a number of fine white tears, which, when broken should somewhat resemble marble in appearance, and after being exposed to the air, should turn a violet red color. That which is soft, black and foul, should be rejected. It is chiefly re-exported, being used in England only as a medicine, but in France also in cookery. In London its price varies from 12s. to £4 per cwt." The use of assafœtida in France is similar to its Indian use, where it is often put into food, being regarded as digestive, and a great preventive of flatulent disorders. It is constantly eaten also by women to facilitate childbirth, and is taken in cases of abortion to promote expulsion of the fœtus.

* The various names given in the "Makhzan" for this drug are—Afarbyún, farbyún, barbayún; farfaryún, abrfayún. In Turkey—Afinan (Arabic), akil bunafshah, and kátil banafshah; háfiz-ul-nihl, hafiz-ul-at fál, kardish-ul-ghinnam; in Greek—Hálás, tákúb, kamályún; and in Syria and Egypt—Bustána; laban us-saudá, laban-i-maghrabíyá, berberya.

the pípal tree (by cutting into the trunk for the sap to flow out) and from the bér tree, but the best he has found to come from the cactus.

"MR. RATH says, that although in the spring time a greater quantity of sap flows, yet a larger *proportion* of the gutta-percha-like substance is gained from the sap that is taken at this time of year."

The cactus is probably the *Columnar euphorbia* (*E. Royleana*) common in the low hills near Jammú.

MR. DREW subsequently wrote.

"I have enquired of MR. RATH more particularly the uses he puts the substance he gets out of the *Euphorbia* to. He mostly uses it for *Steam joints* instead of red-lead, also when mixed with oil, it can be laid on as a water-tight coating to any cistern, &c., and even MR. RATH believes it would do well for a preservative coating for boats.

"I do not know that there is any other purpose to which it has as yet been applied."

On the same subject, the following memo. had been forwarded by DR. JOHNSTONE, Gujrát:—

"COL. GARDINER directed my attention to the experiments made by him of extracting the milky juice of the "doof," which yielded a substance analogous to caoutchouc; the experiments were conducted first by sun-drying the inspissated juice; second by infusion, an extract being prepared from the watery solution.

"I prepared a small quantity by boiling up the "doof." COL. GARDINER could give me no information about the plant itself. I inferred it was a *Euphorbia*. In the vicinity of Kashmere I found *E. verrucosa*, "safaid-hirbí;" *E. longifolia*, "zard-hirbí;" *E. agraria*, "siya-hirbí." The root of the *E. longifolia* I conclude is the "doof" of the Hindoos, on the following grounds. The root of *E. longifolia*, which abounds in the Peer Punjal range, is of the same size and similar consistence; and on exposure to sunlight and air, assumes the same color. Moreover, the reputed leaves of the "doof" sold at the Devee Dwarrah in the Jummoo Raj, the yearly rendezvous of thousands of Hindoos in October, which I obtained from thence, are the leaves of the *E. longifolia*.

"'Catimandoo,' which has been prepared both in Arabia and Persia, is the inspissated juice of the *Euphorbia antiquorum* (?) and quite similar in character to that of the *E. longifolia*.

"I believe gutta-percha, or rather 'catimandoo,' might be prepared from any of the *Euphorbias* by incising their stems and allowing the milk to form into agglutinated tears, or by collecting and boiling it, as I have seen with the juice of the *Horea* in Demerara and Brazil.

"BRANDE gives the analysis of East Indian *Euphorbia* juice as—

"Resin, 60 per cent.

"Wax, 15 per cent.

"Malates of potash and lime in variable quantities.

"Caoutchouc in variable quantities.

"The active principle is the wax resin, and has been added to the *Acetum cantharides* (Edinburgh), to intensify vesication. I believes there exists a greater amount of 'catimandoo,' and less wax resin than BRANDE makes out. Perhaps he analyzed the Plains *Euphorbia*.

"It might be interesting to compare the analyzed juice of the

"*Urceola elastica* (*Gumtavan* of Malay.)

"*Ficus elastica*.

"*Bassia elliptica*.

"*Siphonia caoutchouc*, *Horea* of S. America, and the Hill *Euphorbia* or 'hirbí.'"

1598.—[ ]. Akákiá. Lahore bazar.

A black or brown highly astringent exudation from the seed vessels of *Acacia vera*.

1599.—[ ]. Sakámuniya.

Properly, as its name implies, the extract of scammony; but a spurious kind is sold, which is a black resinous compound.

1600.—[4137]. Hukm chíl, or gond-i-chuhára.

Is a glossy dark-brown gum. The samples exhibited were soft enough to be flexible. It is produced by the date tree (*Phœnix sylvestris*).

1601.—[ ]. 'Usárá rewand, gamboge.

Cambogia cochinensis (Kœnig). *Garcinia mangostana*; *Gambogia gutta* (L.); and *Hypericum pomiferum* (Roxb.); are sources of gamboge. Siam and Cochin China are the great places of production.

A gamboge tree abounds on the Ghâts on the Canara coast, and among the Wynaad mountains (*C. tinctoria*). Ceylon gamboge is produced from *Hebradendron cambogoides*. The gamboge seen in the shops, consists of fragments of the "pipe gamboge" of commerce, which consist of the gum purified and formed into thick sticks or pipes: it comes from Cambodia, Siam, and Cochin China, &c.

This is exclusively imported. It is used in medicine—a drastic—and its native name, "concrete extract of rhubarb," has its origin in the belief that it is prepared from rhubarb. It is used in Europe extensively as a paint in water-color drawing. I do not think the native artists use it. This gum is inodorous and nearly insipid, but is a powerful purga-

tive or drastic, and forms the main ingredient in "Morrison's Pills," which are said to be imported into China by the hundred weight.

1602.—[ ]. Anzarút (*Sarcocolla*). Lahore bazar.

This is a brown colored gum resin, said to be exuded by *Penæa mucronata* and other species, and to have the power of agglutinating wounds, as its name (sarcolla) implies. It has a sweetish nauseous taste, and contains a peculiar principle, called "sarcocollin"* never found in any other vegetable, which has the property of forming oxalic acid when treated with nitric acid. ENDLICHER says, the drug is not likely to be the produce of a *Penæacean* plant.

1603.—[ ]. Juice of the madár or "ak" (*Calotropis Hamiltonii, C. procera*, &c., &c.)

The annexed papers are reprinted from the now scarce early volumes of the Agri.-Hort. Society of India, viz., Vol. VIII.

The "madár" plant gives out a milky juice resembling gutta percha. There was a specimen in the International Exhibition of 1862, shown by DR. SHORTT of Chingleput, Madras; and DR. RIDDELL calculates that 10 average sized plants will afford as much juice as will make 1lb. of this gutta percha-like substance. This plant also produces in its bark one of the strongest fibres known, and is used for making fishing nets on the Indus; but it is difficult of extraction. The bark of the root resembles very much ipecacuanha in its properties.

"On the juice of the "madár" as a substitute for gutta percha, communicated by CAPTAIN MEADOWS TAYLOR.

"My dear Sir,—I observe in the last number of the Society's Transactions, that the mudár (*Asclepia gigantea*), affords a very valuable kind of hemp or flax; and I have now the pleasure to communicate to you another valuable property it possesses, which has been lately discovered by a friend here, under whose permission I make the present communications to you.

"DOCTOR RIDDELL, the Officiating Superintendent Surgeon of the Nizam's Army, had for some time been employed in extracting or determining by chemical experiments the well known medicinal properties of this plant, and during his investigation, having had occasion to collect the milky juice or sap, and expose it to the air, found, as it gradually dried, that it became tough and hard, and not unlike gutta percha. This induced him to treat the juice as that of the gutta percha tree is done, and the result has been the obtaining of a substance apparently precisely analogous to gutta percha, of which I have the pleasure to send you a specimen, bearing the impression of his seal, marked No. 1.

"The mode of preparing this substance is as follows:—

"The juice or sap to be collected by incision. An open slit may be made in the back of the plant and a pot tied to it, when it will flow into it; or it may be collected by cutting the back and catching as much as flows out at once. DOCTOR RIDDELL calculates that ten average-sized plants or bushes will yield as much juice as will make a pound of gutta percha substance, but it is not known yet how far the plant will bear tapping without injury, nor how often, or at what intervals the extractions of juice might be made.

"The juice extracted may either be exposed to the sun in a shallow vessel, or left to dry in the shade: by the former process, the substance becomes a little darker than by the latter.

"When it has attained a tough consistency, it may be well worked up in very hot water with a wooden kneader, or boiled; either process serves to remove an acrid property of the juice, as also all other matter but the gutta percha itself. It is believed that the more it is boiled and worked up, the harder it will eventually become when cool.

"Comparison with the true gutta percha gives the following results:—

"Sulphuric acid—clears it.

"Nitric acid—converts it into a yellow resinous substance.

"Muriatic acid—has very little effect upon it.

"Acetic acid—has no effect.

"Alcohol—ditto.

"Spirit of turpentine—dissolves it into a viscid glue which, when taken up between the finger and thumb, pressed together, and then separated, shows numberless minute and separate threads.

"The above chemical tests correspond exactly with the established results of the real gutta percha.

"The substance, however hard it may have become, becomes immediately flexible in hot water, and readily takes any form required, receiving and retaining impressions of seals, ornaments, &c. It has been made into small cups and other vessels which are not found to alter in form.

"A test I suggested myself was, would it unite with gutta percha? and this was satisfactorily proved in my presence. A piece of the real gutta percha of similar size, with a piece of the new substance was softened in hot water, and united readily.

"The tests by acids on the mixed substance did not differ from those on either of the two original substances. * * * * * * * *

* LINDLEY, Veg. Kingdom, 578.

"If the 'mudár' could be profitably grown for its hemp alone, it is evident, if this new substance proves in practice what it now appears to be, that an acre of cultivation of it would produce a large quantity of juice and thus materially enhance its value. The poorest land suffices for its growth, but I have no doubt that if cultivated and plentifully irrigated, not only would the yield of juice be larger, but the growth of the plant, and the fineness of its fibre when made into hemp, materially increased."

Substitute for Gutta Percha.—(From the *Bombay Times* of 4th Nov., 1852.) The following is a very interesting extract from a note from DOCTOR RIDDELL, containing an account of the experiments made by him on a substitute for gutta percha, which he believes he has discovered. The subject is most important, and if we can make a common hedge plant yield a product so valuable, and the demand for which is so certain quickly to out-run supply, a material addition will have been made to the productive resources of the country.

"I have now the pleasure of sending you the result of my experiments on the juice of 'mudár,' and which, I think, will be found to assimilate closely with all the properties of gutta percha. A nearly similar substance is procurable from the juice of the milk bush or hedge at it is called, the *Euphorbia tiraculli*, only when it hardens after boiling it becomes brittle; whilst warm it is as ductile as the other, and becomes hard quicker, without any of the peculiar scent of the *Asclepias gigantea* juice; it readily dissolves in spirits of turpentine, but is not affected in alcohol. As the juice is very acrid, and blisters the skin, giving most excruciating torture, if the slightest particle gets into the eye, care must be taken in collecting it: however, a machine could easily be made for chopping up the boughs and expressing the juice, so that it need never be touched by the hands. The juice of the elegant plant of the same species, the *Poinsettia*, which has such a beautiful effect in the garden when the leaves turn scarlet, gives a similar substance, but does not harden when cool as the other does; but is still firm enough to be twisted, and would make a good varnish in a solvent like turpentine, and then mixed with spirit. The plant grows readily from cuttings, but requires water, which the other two do not.

"As regards my experiments with the 'muddár' juice, they are as follows:—Having collected about 18 fluid ounces I had it strained through a cloth, and exposed 13½ ounces of it to solar evaporation on a flat dish. In three days it became firm, separating itself from the dish and easily removed. I then placed it in boiling water, and worked it well about with a spatula, and when cool enough to handle, kneaded it with my fingers; when cool I found it to weigh a little more than six ounces. I then boiled it, and, as it cooled, worked it well again: and on weighing the substance, found it had lost one ounce. It was then pulled out into shreds and boiled a second time, kneading it whilst cooling, and four ounces two drachms, apothecaries' weight was obtained of what I call 'muddár gutta percha.'

"The next experiment was with four ounces of the juice, which weighed four ounces apothecaries' weight, and placing it in a bason, I poured about one quart of boiling water on it, stirring it up, and then leaving it to stand, when it broke into curds which fell to the bottom. I then partially poured off the fluid, and filtered the residue through paper, and on its being sufficiently dry to be removed, found it to weigh one ounce six drachms. It was then worked well in hot water two or three times, and formed into a mass which gave six drachms, thus losing one ounce. On the whole it will be seen that the most economical method of preparing the juice, is by solar evaporation, the residue being nearly double to that of the second experiment.

"Results of the experiment in acids, alcohol, liquor potassæ, and spirits of turpentine, on equal quantities of the 'muddár' made into small pellets, immersed 48 hours.

"Sulphuric acid—Much charred, particularly outside, cut a pellet in half, found the inside spotted, not charred throughout; the remaining part stretching like tough dough.

'Nitric acid.—Appeared converted into a yellow resinous substance, and gained about one-third in weight, which it lost again when dry; found it pliable under pressure of the finger: when mixed with water it colored it yellow.

"Muriatic acid—Colored somewhat like the sulphuric, but not so black; soft and plastic. No increase in weight. Color brownish outside, with a reddish tinge inside.

"Acetic acid—No diminution in weight whatever; apparently the same as when first immersed.

"Alcohol—The substance apparently softened, and lost a trifle in weight; spirit slightly discolored.

"Liquor potassæ—Washed it in warm water and let it dry; had yellowish tinge. Increased a little in weight, but became very ductile and adhesive.

"Spirit of turpentine—Placed one part in four of turpentine, and in 12 hours it was quite dissolved, forming a thick creamy substance; which, mixed with sprits of wine, would make a good varnish for silk or cloth."

RESINS AND BALSAMS.

PINE OR CONIFER RESINS.

I have already indicated the various gums

which are simulated in the druggists' shops by resin. I will add that the "mumiai" is often the same; and also "aluk," "zift-i-ratab;" and "zift-i-yábis," "ratiánáj," and "katrán," are merely varieties of resin, colophony, and dried tar.*

1604.—[4062]. Resin. Hills near Simla. Mr. Geo. Jephson.

1605.—[4062]. Tar, the result of dry distillation of pine chips, both of deodar (*C. deodara*) and *P. longifolia*.

First, an earthen ghara or vessel with a wide mouth, and capable of containing about 4 seers, is sunk into the ground. Next, a large ghara of about 12 seers capacity is taken, and three small holes are drilled in its under side: it is then filled with scraps of the pine wood, and over its mouth another smaller jar is placed, and kept there by a luting of clay very carefully applied; and then both the jars are smeared over with a coating of clay. These two jars thus stuck together are next set on the mouth of the receiver or ghara sunk into the ground, and the joint or seat is made tight by a luting of stiff clay. Light firewood is now heaped around the apparatus and ignited, and kept burning from four to eight hours; the rationale of the process being that the heat causes the tar contained in the chips inclosed in the large ghara to exude, and it falls though the three holes drilled in the bottom, and into the receiver sunk into the ground. When the fire is out, the ashes are raked away, the jars very carefully separated, so that pieces of dirt may not fall into the receiver, and the latter is then exhumed, and the contents poured out. It is only necessary to replace the receiver, with the jars over it as before, duly charged with chips, and lute the joints up carefully, and the process can be carried on as before. With care the same jars may be made to do over and over again without cracking.

One seer of wood yields about 2·6 chitaks of tar, and 4·3 chitaks of charcoal. To procure a seer of tar requires 6 seers 4 chitaks of wood chips to charge the pot, and 2 maund 6 seers and 9 chitaks of chips for fuel.

1606.—[4073-5]. Samples of crude turpentine and tar, from the *Pinus longifolia*. Kangra district.

And also from the *Cedrus deodara*, the latter being used in the preparation of the large skins which are used as floats on which rivers are crossed, &c. Tar is called "chiloh."

1607.—[4103]. Baroza, or ganda-baroza, the oleo-resin exuding from the "chil," or *Pinus longifolia*. Amritsar bazar.

A sample is sent from Rawalpindi also. This is to be met with in every bazar, every tinman has a little pot of it to use while soldering metals. The "ganda-baroza" will yield, by further distillation, spirits of turpentine and rosin.

1608.—[ ]. Refined spirits of turpentine, prepared at Sealkot Mission Industrial School. Rev. J. Gordon, Sealkot.

1609.—[4104]. Colophony, or black rosin, the residue after distilling the above.

1610.—[4161]. Pure rosin (red or pale rosin). Dera Ismail Khán. Local Committee.

I have no accurate information as to where this fine sample was produced: it gained a prize: possibly it was imported into Dera Ismail Khán.

1611.—[4171]. Resin as it exudes from the "chil" tree. Peshawur.

(4129) Is a sample from Lahore.

These samples consist of the resinous tears exuded from the bark, picked off and dried.

Natives generally attach little value to turpentine, and therefore often prepare resin from the turpentine (ganda-baroza) by merely heating it in an open vessel, by which means the essential oil (spirit of turpentine) flies off, leaving the resin. This wasteful method is very generally followed.

1612. [4117]. Sundras, or sundrus; resin of the *Vateria indica*. Lahore bazar.

This resin is called by the various names of "East Indian copal," "Indian animé," and "Piney dammer;" in Hindí, according to the "Makhzan ul-adwiya," "chanderús;" and "kahruba" among the common folk. The author goes on to state, that an author, Muhamad bin Ahmad bin Zakria says, there is a fountain in Central Hindústán which yields "sundras" in a liquid form; others, with the inhabitants of Malacca, say it is yielded by the camphor tree (dirakht káfúr). The English call the tree árpénirús (Juniperus family, *Thuja articulata ?*), and that "sundras" exudes from the tree in the day time, and camphor*

* Royle's Illustrations, p. 352.

* Amber is called in Hindi "kapúr." I have no doubt on ac-

by night. I have seen four qualities of "sundras," one is yellow and red inside, and shining; another is pale yellow, and somewhat soft; a third is somewhat grayish and more or less opaque, and is found in huge rough masses: containing pieces of bark, dirt, &c., this is the inferior quality. A fourth quality is dark colored, light in weight. It is exclusively imported from Bombay, at which place there are to be found two kinds—one of which is the product of the *Vateria indica*, and comes from Travankúr and Malabar, &c.; the other from Zanzibar and the mainland near. *Vateria indica* is the *Elæocarpus copaliferus* of Retz., and the *Chlorowylon dupada* of Buchanan.

The "animé" of *Hymenœa verucosa* and *H. courbaril*, is quite different from the present samples.

Good "sundras" is a clear amber colored resin. The finest pieces are sold as "kahruba" or amber, and amulets are often made of the resin to imitate amber.

The resin boiled with linseed oil yields a fine varnish, which is especially used by carriage builders. If boiled slightly, and only fine samples be used, it makes an excellent varnish for the painter in oils. If very clean specimens are dissolved in spirits, or even oil (linseed or poppy), a fine clear varnish for maps is the result. Papers to be varnished are, by the natives, first painted thinly over with a size made of rice and water; when this is dry the varnish is applied, and the size prevents it soaking through the paper to the other side.

It is not surprising that natives should have fallen into the error of considering "sundras" and amber the same things, since, at Zanzibar, whence the African "sundras" comes, the pieces of resin are actually found lightly imbedded in the soil. There are two kinds sold by the Zanzibar merchants—"zamití" and "chakázi."

BURTON says, "that the true or ripe copal, properly called 'sandarúsi,' is the produce of vast extinct forests. The gum buried at depths beyond atmospheric influence, has, like amber and similar gum resins, been bituminized in all its purity."* This buried gum is found imbedded in a crumbling touchwood, which once was a solid tree. DR. ROYLE says, that the African "sundras" (or a substitute for it) is produced by *Callitris quadrivalva (Thuja articulata*, Desf.)†

1613.—[ ]. **Kahruba (real amber). Lahore bazar.**

This is imported from Russia, Astrakhan, &c. The native druggists name Arús (Russia) and Balghár. No doubt a certain quantity comes this way, and goes to Yarkand, &c., from which district the hill people of Ladákh, Spiti, &c., obtain the amber beads, that are often to be met with among them.

1614.—[4100]. **Mustagi-rúmí, or mustagi. Amritsar.**

Called in Arabic, "'alk-baghdádi," and "árah;" also "mustáki."

(4112) Lahore.

A terebinthate resin. The real mustagi-rúmi is produced by the *Pistacia lentiscus* or *P. altantica*. This grows on the shores of the Levant and parts of Greece, &c., and in the islands of the Greek Archipelago. From Scio, this resin was called by the Greeks, σχίνος, as it is peculiarly abundant in that island. The tree seldom rises above 12 feet high; the leaves are abruptly pinnate, green above and pale beneath. Mastic, besides being a valuable source of varnish in the arts, is used as a masticatory (this word is derived from mastic), to preserve the teeth and sweeten the breath. As a medicine, AINSLIE mentions, that it is prescribed by native doctors in conjunction with salep "misri." It is a tonic and hepatic. The resin occurs in small brittle tears of a pale yellow color: these tears get rubbed together in carriage and covered with a whitish powder like other resins. It is nearly inodorous until heated, and then it has a pleasant smell. The "mustagi" of the bazars is seldom if ever the Turkish mastic; but the species called *P. cabulica* and *P. khînjak*, grows all over Sindh, Bilúchistán and Kábul—from these places the resin is brought; as also pistachio nuts, khinjak fruit and the Bozgand dye stuff (mastic tree galls).

1615.—**Sál resin, or rál.**

The resin of the *Shorea robusta*, occurring in brittle stalactitic pieces, of a pale creamy yellow, nearly opaque. Each piece has a striated appearance, as if the resin had run out in thin liquid streams, which had coagulated on the surface, one over the other.

This is a common gum, and to be found in every bazar, and that of the same kind and appearance: it is chiefly imported, as the "sál" tree is not common. In Hushyarpúr and Jálandhar there are some sál jungles. (*Vide* "Woods".)

DR. BIRDWOOD observes, that the "rál" imported to Bombay from the Punjab is not similar to the "dammar" of the *Shorea robusta*, which he describes as transparent amber-colored, like *Vateria indica* gum. This point deserves attention, but the semi-opaque striated "rál," above described, is always accepted as *S. robusta*.

count of the confusion natives makes between the gum and the camphor tree and amber.

*"Lake Regions of Central Africa," II., 403-5, quoted by DR. BIRDWOOD, p, 267.

† Illustrations, p. 352.

BALSAMS.

1616.—[4110-4134]. Benzoin, lúbán. Two samples. Lahore.

These are of two qualities—one having a much whiter appearance—this is the best.

Gum benzoin, corruptly called Benjamin, is the produce of *Styrax benzoin* ; it is called "lúbán" or "úd-i-lúbán," also "dhúp" (incense). The name "lúbán" is not to be confused with the "labbán," which is the Arabic name of olibanum. Benzoin is sold in somewhat brittle agglomerated pieces, which are amygdaloid in structure, and mixed white and brown. It burns with a pleasing fragrance. The best varieties however are almost entirely whitish with a pink cast, retaining their amygdaloid form. The constituents of benzoin in 100 parts, are, as obtained by BRANDE :—

Benzoic acid, ...	9·0
Acidulated water, ...	5·5
Empyreumatic oil, &c., ...	60·0
Charcoal, ...	22·0
A mixture of carburetted hydrogen and carbonic acid, ...	3·3

This fragrant resin is entirely imported. It is produced in Sumatra and exported from Acheen ;* but grows also in Prince of Wales' Island, &c., and there are plants in the Botanic Garden at Calcutta. It is given by native doctors in asthma : and the vapour of the burning gum locally applied to hœmorrhoids.

1617.—[ ]. Khún siáwashán ; hírádá khún ; dam-ul-akhwain. Dragon's blood. Lahore bazar.

This is a resin tinctorial, which, when ground up, gives a fine transparent red. It is, however, inferior to the lac lakes and madder lakes of the artists' colormen. It is sold in fragments of a dark red color —hence its name of dragon's blood. It is enumerated among the drugs in the Bagdád bazar, where it is said to come from India. It is the produce of *Pterocarpus draco* or *P. indica* (Willd.), and not the *Dracœna draco*, which is peculiar to the Island of Teneriffe. NIEHBUHR mentions a tree (probably *Pterocarpus*) in the province of Haidramát in Arabia Felix, as producing dragon's blood ; and AINSLIE refers this to the *Calamus draco*, and says, the dragon's blood of the Indian bazars is derived from Java, and Islands in the Indian Archipelago.

The following is a list of gums, sent from Madras by the Agri-Horticultural Society. Many of them are derived from trees which are not known in these parts, but at the same time several others are found in our hills, and therefore their gums may be met with.

* AINSLIE, Mat. Med., I., p. 33.

While nearly all the Punjab gums are remarkably pale in color, and hardly one, except the kino (*Butea frondosa*) is dark-colored ; it is remarkable to notice the fine deep reds, browns and black colors of the Madras gums, there being hardly one white sample among them. The list is as follows. The botanical names given here are those marked on the original papers containing the specimens, and are on the authority of the writer of those papers.

Nim tree gum—*Azadirachta indica*—Brownish gum, much mixed with impurities.

Gum of *Pongamia glabra*—a thick black untransparent exudation.

Gum of *Anacardium semecarpus*—the marking nut tree—a black gum.

Gum of *Diospyros embryopteris*—in black nodules, with wrinkled surface.

Gum of *Borassus flabelliformis*—black ; fracture black and shining.

Gum of *Calophyllum inophyllum*—(Alexandria laurel)—black.

Gum of *Terminalia tomentosa*—red gum, black outside the pieces.

Gum of *Acacia lebbek*—an amber brown gum.

Gum of *A. arabica*—a dark colored gum, much mixed with bark and with impurities.

Gum of *Ailanthus excelsis*—a red gum, black outside.

Gum of *Spondias mangifera*—a red gum, black outside.

Gum of *Nerium suaveolens*—dull red gum.

Gum of *Barleria prionitis*.

Gum of *Pterocarpus marsupium*—Malabar kino.

Gum of *Odina wodier*—dark red gum.

Gum of *Melia sempervirens* (Bukhain)—looks like "mochras."

Gum of *Eriodendron anfructuosum*—black and untransparent, looks more like a gall than a gum.

Gum of *Poongallee* (*Gyrocarpus Jacquini ?*)—black, like dried tar.

Gum of *Tricosanthes cucumerina*.

Gum of *Moringa pterygosperma*—very dark colored.

Lákh, from bér tree. This is the lákh of Mysore and Southern India, and is very superior to Punjab lákh. The great thickness and uniform continuance of the crust is remarkable.

Gum of *Careya arborea*—greenish gum.

Gum of *Feronia elephantum*—clear yellow gum, soluble in water.

Gum of *Thespesia populinea*—a red gum.

Gum of *Ponciana alata*.

Gutta percha from *Euphorbia*.

Gutta percha from *C. gigantea*—madár.

REPORT ON GUMS AND RESINS.

CLASS IV.—SUB-CLASS (A).

THE JURY WAS COMPOSED OF THE FOLLOWING GENTLEMEN :—

MR. R. H. DAVIES,
MR. R. EGERTON,
MR. F. E. GORDON,
DR. B. BROWN,
DR. F. ELTON,
MUNSHI HARSUKH RAI,
SIRDAR JASSA SINGH, *of Amritsar.*

REPORTER—MR. B. POWELL.

THE collection consists of (1st) a series of genuine gums, soluble in water, which are all the produce of the Punjab. The use of the first division is principally in the arts, although a few are astringents, and others useful as a mucilaginous vehicle in medicine.

2nd. Gum resins, soluble in spirits of wine, which are almost without exception imported; one or two of them, such as mastic and "gŭgal," or Indian Bdellium, are the produce of the Sindh and Bilúchistán Hills; one or two of these again are found to the north of these countries, such as assafœtida, in Kandahár and Herát; some more, as "jaushír" *(Opoponax)* and *Sagapenum*, are produced in Khurasán and Persia proper; while the remainder are brought from the provinces of Arabia and Africa, by means of the ports of the Persian Gulf to Bombay, whence they are distributed over the Punjab. One of this class, gamboge, comes wholly from southern latitudes of Siam and Cambodia, being imported *viâ* Calcutta; and the dragon's blood, it is not certain whether the *Pterocarpus* producing it is an inhabitant of Arabia Felix, or whether it comes from the Indian Archipelago.

The use of this class of gum resins is principally in medicine; while the fragrant odours which some of them yield when burnt, have rendered them famous from antiquity, as used in heathen temple worship for incense. The aromatic properties and bitterness of others, as myrrh, have rendered them valuable as antiseptics; and the ancients used them in embalming the dead.

The third division consists of resins, including balsams, which are distinguished from all other resins and gum resins, by containing benzoic acid.

The genuine resins are principally the produce of the pines of the Kohistán—the "chíl" *(Pinus longifolia)*, the deodar *(Cedrus deodara)*, and some others.

These yield a semi-viscous resinous substance, which, on distillation, yields turpentine; and if the process be stopped when the turpentine has passed over, the residue will be a clear brown and red resin. If the distillation is carried on still further, a blackish liquid, which DR. URE calls "balsam of turpentine" passes over; the ultimate residue is black resin, or "colophony" (chíloń).

The deodar yields a kind of wood-oil, of a dark color and strong smell, which is highly

antiseptic, and is used in preparing inflated skins for river use, and to preserve timber from insects.

The chips of wood from both these conifers, yield, by dry distillation, an excellent tar.

One very important resin, the Indian copal, reaches us both by Calcutta and Bombay. The "sál" resin also comes from Hindústán, and benzoin is imported by Calcutta, sometimes also by Bombay, from Sumatra and the Archipelago.

The wood-varnishes, liquid balsams, such as tolu, copaiba, and "liquid-ambars," are unrepresented.

It is not to be wondered at, that the number of indigenous gums in the Punjab should be small, as compared with the products of Southern and Central India. We have only to compare the tropical forests of the one, abounding in almost endless varieties of vegetable forms with the level plains of the Punjab, scantily wooded, and producing almost the same forms over the whole province, to infer such a conclusion.

It is only when we ascend the hills that the luxuriance of vegetable life opens out around us; and even here, the luxuriance does not exhibit itself in a larger production of gummifers. Nor is it possible to ignore the effect of climate in promoting exudations from many trees that are by nature gummifers, and yet yield abundantly in one country, and never in another. In the Madras list are to be found the gums of many trees not unknown in the regions of the Himálaya, and some even in the Plains, such as *Azadirachta indica, Pongamia glabra, Calophyllum, Terminalia tomentosa, Spondias, Nerium, Melia, Careya, Feronia*, and others; and yet there is not a specimen in the collections of the gums of any one of these. No doubt a more careful examination of trees in portions of the hills would lead to the extension of our series, but this want of research is not wholly sufficient to account for the difference.

The Jury, however, would suggest, that against the occurrence of another Exhibition, residents in, and visitors to, the hills, interested in economic botany, should extend their search and enquiry for new or unnoticed gums and resins; and that a handsome prize should be offered for the best collection of such uncommon gums.

Before leaving this subject, the Jury desire to record their sense of the value and interest attaching to the carefully named collection of gums from the Madras Presidency, both as inciting to the enquiries just alluded to, and as serving for the purposes of illustration and comparison.

Before entering on a consideration of the individual samples exhibited, the Jury present to notice a comparative list of the collection of gums indigenous to the province, arranged as products of hill or plain districts.

PLAINS.

Gum of *Acacia arabica*—babúl.
" *A. vera*—kíkar.
" *Vachellia Farnesiana*—choti kíkar.
" *Acacia odoratissima*—siris.
" *A. modesta*—phulái or bimbri.
" *Tamarix indica*—vadhál.
" *Prunus alucha*—alúcha.
" *Amygdalus persica*—árú.
" *Butea frondosa*—dhák.
" *Mangifera indica*—ám.

HILLS.

Odina wodier—jingan, kaimal.
Bombax heptaphyllum—sembal (mochras).
Conocarpus latifolius—dhao or dhoñ.
Acacia catechu—kherí or khair.
Armeniaca vulgaris—shaftálú.
Cochlospermum gossypium—katíra (?)
Resin of *Pinus longifolia*—chil.
" *Cedrus deodara*, kelu.
And other conifers.
Sapindus acuminatus—dodan.

Plains.	Hills.
Gum of *Moringa pterygosperma*—mochras; sohájna.	*Artocarpus integrifolia*—dhárú.
„ *Prosopis spicigera*—jhand.	*Spondias mangifera*—ambárá.
	Albizzia odoratissima—kurmrú.
	Cerasus puddum—pajjú.

Perhaps "sál" resin (*Shorea robusta*) might be added, as there are thickets of "sál" in the Jálandhar Doab.

The Jury remarked the following specimens in the collection as being worthy of notice.

Gum Arabic.—The samples vary in color from white to brown. Some very excellent samples consist of a mixture of white, yellow and reddish pieces. The majority of samples are, however, not well picked, and contain much bark and other foreign matters. The gums sold as Arabic are probably the produce of any or all of the species of *Acacia* that are commonest in the district whence the sample comes; but there is not that great variety described as noticed in some samples of gum arabic in the English Exhibitions of 1851 and 1862, where one sample of Arabic was said to be a mixture of twenty-four gums, and to contain the gum of *Feronia elephantum*, *Acacia catechu*, and many others. The native doctors use gum arabic as a tonic, and distinguish between the red pieces and the white, which are said to exude at different seasons of the year.

Some specimens of the gum arabic are in highly friable nodules: this is said to be caused by rain falling on the tears of gum after they have exuded from the tree, which moistens them, after which they are immediately dried again by sun and wind.

Gum arabic is much used as a mucilage in European medicines; but the hospitals and dispensaries of the Punjab are still mostly supplied from Calcutta. As arabic of excellent quality can be produced by the Punjab districts, there is no reason why the gum should not be supplied here.

The points that need attention are, careful picking of the gum, so as to avoid mixing it with pieces of dirt, &c., &c.; and then the gum should be sorted into first, second, and third qualities.

The best sample of gum arabic was that from Dera Ghází Khán (4167), being clean, well picked, and in pieces of an uniform size. The Jury award to this sample a Prize of Rs. 20. The sample from Delhi is also very good, being uniform in color and free from dirt.

There is also a fair sample from Sirsa, with information on the box lid to the effect, that the gum is collected in March and April, that it is much used in the manufacture of sweetmeats, and is exported eastward.

A coarse kind of arabic, or more probably "siris" gum, of a deep amber color, is called "lera" and used by calico printers, who stamp the fabrics with patterns in gold and silver leaf, and which adhere by the aid of mucilage. "Siris" gum is not soluble entirely, but softens into a jelly-like size.

The gum of the *A. modesta*, "phúlah," is in little curled pieces, quite soluble and of a yellow color.

There is a curious gum exhibited from Hushyarpúr, called "kaimal" (*Odina wodier*). The sample is a pale brown color, in a large cylinder, hollow at the centre, and the gum forming in a radiated structure, much more dense outside than in; it has a sour taste, like paste that has turned sour; is pale brown color, and is soluble. It is used to mix with whitewash and plaster. There is no other sample like it. The piece exhibited is evidently

artificially formed by dissolving the crude gum, and allowing it to evaporate and recoagulate in its present form. There is also a piece of brownish gum adhering to the bark of the tree, and called "kamal," exhibited from Jhilam.

There was one sample of white gum of the *Conocarpus latifolius*—it came from Kangra.

There is also one sample of a white gum from the mango tree, sent by the Delhi Committee.

A fine sample of white stalactitic pieces of the gum of *Odina wodier* is sent down from the Simla hills. This sample merits special mention.

There are several samples of "sohájna," gum of *Moringa pterygospermum*, these are frequently called mochras—a name also given to the gum of *Bombax heptaphyllum* (sembal), and to the imported galls of the areca palm, also called "phúl supyárí."

Most samples of "sohájna" are of a dark color, but containing some pieces of a pale waxen rose pink; the latter pieces are the best. The Jhilam samples contains, besides the pink sort, some pieces that are very nearly white.

There are several specimens of the East Indian kino, or "kamarkas," produced by the *Butea frondosa*, or "dhák" tree. The gum occurs in little fragments of a ruby red, which turn black and opaque by keeping. This gum is a powerful astringent, and would be valuable in tanning leather, except that it imparts its color to the hides, and spoils them. In native medicines, it is eaten as a medicine with ghí and sugar, and supposed to strengthen the liver and loins, and to be tonic and aphrodisiac, whence its name of "kamarkas." On account of its astringent properties it is used in European medicine.

The finest sample was sent from Gurgaon (4053), and to it the Jury award a Prize of Rs. 10. The Gujrát sample was also clean and good.

GUM RESINS.

None of these are produced in the Punjab but are imported. Ammoniacum, "ushak, jaushír" (*Opoponax*) and assafœtida, all referred to species of Umbelliferæ, are commonly met with in the bazar; but it is absolutely impossible to get genuine "sakbinaj"* (*Sagapenum*), except here and there a fragment at a very high price. The samples exhibited are all "jaushír," which is commoner. Ammoniacum is the cheapest of all. Galbanum (bárzad and barija) is not to be obtained. The reporter endeavored at Amritsar to get a sample, but without success; various samples of resin (baroza or barija) are always sold in its place. The particulars of these gums are given in the preceding pages, and so are not repeated here. The five gums—"Ushak," "jaushír," "sakbinaj," "bárzad" and "farfeyún," are classed together by native doctors as remedies for rheumatism. Some of them become viscous after long trituration, and the druggists submit them to this previously, as they suppose it brings out the virtue.

The sample of "gúgal" from Amritsar, in this series, is remarkable fine and pure.

RESINS.

A fine sample of "sál" resin (*Shorea robusta*) is sent from Gurgaon, in nearly opaque pale yellow striated stalactitic pieces.

There are several specimens of the semi-viscous whitish "gunda baroza," or crude turpentine of the "chíl" (*Pinus longifolia*).

* A sample exhibited with the name of "sakbinaj," from Amritsar is quite another substance. It is a black resin, containing fragments of impurities, and little greenish tears, here and there interspersed: it had a bitter taste and a slightly alliaceous smell. It might have been the resin of an *Amyris balsamodendron*; but was certainly not Umbelliferous.

Dera Ismail Khán exhibits a very fine sample of pale resin (4161); to this the Jury award a Certificate of Merit. This resin is however, prepared by an exceedingly wasteful method. The crude turpentine is heated slowly in an open vessel, and hence the spirit of turpentine, which is the most valuable product, is allowed to fly off in vapour! Such an error is very easily rectified by performing the process in a closed still. There is also a fine sample of black resin, or "colophony," prepared at the Sealkot Mission Industrial School. This sample is accompanied by some very excellent pure spirit of turpentine, which is distilled from the ordinary "gunda baroza," and the "colophony" is the resulting residue after distillation. The Jury recommend that for this sample, together with pure turpentine, which is first-rate, a Silver Medal and Certificate be awarded.

There are several samples of East Indian copal, or "animé." These are all invaluable in the arts, as furnishing a varnish for the carriage builder and the cabinet-maker, while if the white varieties be selected, and white poppy oil be used with it, a clear and colorless varnish for maps is obtained. On sending to Amritsar for various qualities of this resin, about six were obtained. The first being a clear and beautifully transparent resin, perfectly clean and of a very pale whitish yellow; the next amber-colored; a third clean, but clouded and horn-like as to transparency; a fourth was a little much worn and rubbed pieces of a brown color; a fifth was really black, but, as I believe, really a *Coniferous* resin; and a sixth was exactly like amber. I have little doubt, that the first four are of Indian origin, from *Vateria indica;* and that the last was African "animé" from Zanzibar; where, according to BURTON, it is found loosely imbedded in the surface soil of the thickets where the trees grow, thus commencing to go through the process that genuine amber has already passed though ages ago; and this accounts for the similarity. This kind of copal is constantly passed off as real amber by native salesmen, and called "kahruba."

BADEN POWELL,

Reporter to the Jury.

SUB-CLASS (B). OILS AND COMPOUNDS OBTAINED FROM OIL, INCLUDING OIL SEEDS.

This Sub-class includes—

1st. Burning, lubricating, and esculent oils.

2nd. Fragrant oils and attars, and medicinal oils.

3rd. Oil compounds, as soap, &c.

Along with Nos. 1 and 2, are included the seeds, &c., yielding the oils.

The importance of oil in this country cannot be over-estimated, and the consumption of it is something wonderful. It is largely used in cooking; for as the principal nourishment of the great majority of the population is vegetable, carbonaceous substances, such as oil and ghí are requisite for mixture: besides this, oil is used by many natives, who rub it over their bodies; and the use of oil for lighting purposes is too obvious to need mention. If the consumption of oil is stated as 1 oz. per diem for nearly every man, woman and child in the province, we have a daily consumption of oil amounting to more than 10 millions of ounces.*

The following table from Jálandhar district, will show the cost and value of the most common oils:—

Description.	Produce per acre.	Yield of oil per 1 md.	Cost.	Value.
	MDS.	SEERS.	R. A. P.	RS.
Tárámíra, ...	2	13	1 3 0	2
Sesamum, ...	2	16	2 10 0	6
Sarsoń, grown after maize, múng, &c.,	4	13	2 11 0	8
Linseed, ...	3	16	5 0 0	6

* The total population of the Punjab in 1865, was 12,717,210, so that 10 millions is within the mark.

And as to the proportion produced in Gujrát, it is stated that—

Sarsoń yields	⅓	of its weight in oil.
Til (*Sesamum*),	⅖	„
Tárámíra,	¼	„
Kussumba (*Carthamus*),	½	„

1618.—Tel sarsoń, or kharwá tel, or raughan siya, mustard oil and rape seed oil.

There are four varieties—which will be catalogued *seriatim*—all species of mustard.

1st. The "sarsoń," "sarhoń" or "sarshaf," rape seed oil (*S. juncea*).

2nd. "Rai," mustard. (See *S. campestris.*)

3rd. "Torya."

4th. "Tárámíra" (*S. eruca*).

"Sarsoń" seed was exhibited from the following districts—

(2552) Delhi (black).
(2569) Gurgaon.
(2603) Hissar.
(2679) Ambálah.
(2696) Ludhiana.
(2719-2720) Simla.
(2770) Mahlog.
(2832) Jálandhar.
(3859-3055) Kangra (black).
(2892) Kangra (variety).
(2975) Kangra (red).
(3148) Lahore.
(3198) Rawalpindi.
(3226) Rawalpindi (black).
(3247) Jhilam.
(3271) Bhera of Shahpúr.
(3298) Gugaira.
(3352) Muzaffargarh.
(3376) Dera Ismaíl Khán.
(3463) Hazara.
(3480) Kapúrthalla.
(3503) Srínagar.
(3504-05) Srínagar (variety).

From Sirsa district it is noted that "sarsoń" yields one-third of its quantity in oil. In Rohtak "sarsoń" is sown in ridges between the fields of wheat and barley. The cost is from 4½ to 4¼ seers per rupee, but varies considerably; export is both in the direction of Bengal and Kárachí.

In MAJOR CLARKE'S "Agriculture of the Rechna Doab," the cost of cultivating "sarsoń" (one acre) is thus given:—

Produce.	R.	A.	P.	Cost.	R.	A.	P.
8 maunds,	8	0	0	Government revenue, ...	2	0	0
				Lumberdarí, &c.,	0	4	3
				Seed, 5 seers, ...	0	3	0
				Reaper, 1 maund 8 seers, ...	1	3	3
				Sweeper, 20 seers,	0	8	0
				Potter, Carpenter, Dhurwaie and Blacksmith, 3 seers each; Dhurmsala, 1¼ seer,	0	5	6
				Total expenses, ...	4	8	0
Total, ...	8	0	0	Total gross profits, ...	3	8	0

"Sarsoń" or "sarhoń" oil, rape seed, is the cheapest and commonest kind of oil. When kept it has a disagreeable rank nitrogenous odor, but is capable of purification by agitation in a leaden vessel, or better still by agitation with sulphuric acid and water. The "khal," or oil cake, after expression of oil, is given to fatten cattle.

Samples were further sent from—

Jálandhar.
Kangra (two varieties, white and black seed).
Hushyárpúr.
Amritsar.
Gujranwalla.
Gujrát.
Jhilam.
Shahpúr.
Gugaira.
Dera Ghází Khán.
Jhind.

A sample of mustard seed grown at Spiti is also sent. The oil is extracted by pressing the seed in a cloth: the "sarsoń" is there called "nawár."

1619.—Mustard, rai (*Sinapis alba et nigra; S. campestris.*

The seed is of two colors, black and white. Exhibited from—

(2570) Gurgaon.
(2621) Rohtak.
(2858) Kangra.
(2918) Hushyarpúr.
(3057) Gurdaspúr.
(3129) Lahore (black).
(3130) Lahore (white).
(3227) Gujrát.
(3299) Gugaira.
(3414) Dera Ghází Khán (white).
(3415-3418) Dera Ghází Khán (black).
(3500) Jammú.
(3556) Nábha.
(2551) Delhi (white).
(2860) Kangra (white).
(2974) Amritsar (white).
(3225) Gujrát.

Mustard oil was sent from—Rohtak, Sirsa, Kangra, Amritsar, Lahore, Gugaira, Dera Ghází Khan, and Jhind.

1620.—Tárámíra (*Sinapis eruca*).

A kind of mustard with a red seed, somewhat elongate. The oil it produces is used as food and for burning, and as a medicine for cattle and horses. It is called "assu" in Punjabí.

(3131) Lahore.
(3188) Gujranwalla.
(3230) Gujrát.
(3249) Jhilam.
(3268) Shahpúr.
(3354) Muzaffargarh.
(3366) Dera Ismaíl Khán.
(3417) Dera Ghází Khán.
(3483) Kapúrthalla.
(2555) Delhi.
(2568) Gurgaon.
(2829) Jálandhar.
(2922) Hushyarpúr.
(2976) Amritsar.
(3061) Gurdaspúr.

Oil of this seed was exhibited from Jálandhar, Amritsar, Lahore, Gujrát and Jhind.

1621.—"Torya" seed, a variety of mustard, was exhibited from—

(2681) Ambálah.
(3156) Lahore.
(3484) Kapúrthalla.

Its oil is hardly distinguishable from mustard or rape seed oil.

1622.—[2555]. Tarah. Delhi.

Also an oil seed of this class.
(2568) Gurgaon.

1623.—Sesamum *(Sesamum orientale). Vern.*—Til.

This plant is being generally cultivated, and often sown round the edges of fields, forming as it were a green hedge to the main crop. It yields a useful oil, which has none of the bad nitrogenous odour of mustard oil; for this reason it is the oil which is employed for burning in all European houses. The seed as it comes from the plant is brown or black, and is called in that state "til siyah;" but it is blanched by warming in hot water, the outer skin of the seed rubbed of, and then the seed is white, and called "til safed." This sells at a higher price, and produces the purest oil. The yield of oil is about two-fifths the weight of seed employed. There is scarce a district in the plains and lower hills that does not produce this seed.

It was exhibited from the following districts:—
(2553-54) Delhi (washed and black).
(2604) Hissar.
(2645) Sirsa.
(2721) Bhajjí, Simla States.
(2757) Kothar, do.
(2769) Mahlog, do.
(2806) Balsan, do.
(2830) Jálandhar.
(2861) Kangra.
(2921) Hushyarpúr.
(2966-67) Amritsar.
(3133-34) Lahore.
(3189) Gujranwalla.
(3196-97) Rawalpindi.
(3228-29) Gujrát.
(3270) Shahpúr.
(3297) Gugaira.
(3353) Muzaffargarh.
(3482) Kapúrthalla.
(3517) Srínagar.
(3535) Nábha.
Dera Ismaíl Khán.

The oil was also sent from Rohtak, Sirsa, Jálandhar, Hushyarpúr, Amritsar, Lahore (two samples), Gujrát, Jhilam, Shahpúr, Gugaira, Dera Ghází Khán and Jhind.

In Sirsa the yield of oil is 16 seers for a maund of seed: it sells at 4 to 4½ seers per rupee, and is exported both towards Bengal and Kárachí.

1624.—Linseed oil *(Linum usitatissimum,* L.) *Vern.*—Alsi; katán (Arabic); kéúñ (Kashmírí).

This seed is extensively cultivated in the Punjab: the native flax produces abundance of seed for oil, while its fibre is inferior; the European seed on the other hand is better for fibre than for oil.

In Kangra it is thrown in among the stubble after cutting the rice crop, and then springs up without any cultivation.

The native seed is smaller, not so long, and of a redder color, than European seed.

The seed is first bruised and then pressed; it yields one-third the weight of seed in oil.

This oil is invaluable for painting purposes; if boiled down to half its bulk, it forms a good drying oil, and is used to make printers' ink. This oil is also boiled with copal (sundras), and forms a first-class varnish.

(2678) Ambálah.
(2831) Jálandhar.
(2862) Kangra.
(2920) Hushyarpúr.
(2973) Amritsar.
(3060) Gurdaspúr.
(3187) Gujranwalla.
(3199) Rawalpindi.
(3224) Gujrát.
(3246) Jhilam.
(3269) Shahpúr.
(3355) Muzaffargarh.
(3375) Dera Ismaíl Khán.
(3482) Kapúrthalla.
(3485) Jammú.
(3486) Ditto from Srínagar (called kéúñ).
(3554) Nábha.

Samples of the oil were sent from Jálandhar, Kangra, Amritsar, Lahore, Gujrát, Jhilam, Shahpúr and Dera Ghází Khán.

The following is from DR. ROYLE:—

"Linseed, or the seeds of the flax plant, are oval, pointed in shape, compressed, with a sharp margin; brownish colored, smooth, and shining on the outside, but white internally, and without odor. The outside has a bland, mucilaginous taste, in consequence of the skin of the seed being covered with condensed mucus. The white part, or almond of the seed, has an oily taste, from containing fixed oil, which is separated by expression.

"These seeds, analysed by MEYER, consist, in one

hundred parts, of 15·12 mucilage (nitrogenous mucilage with acetic acid and salts, according to some) chiefly in the seed-coat; 11·26 fatty oil in the nucleus; in the husk, emulsion, 44·38; besides wax, 0·14; acrid soft resin, 2·48; starch with salts, 1·48; in the nucleus besides the oil, gum, 6·15; albumen, 2·78; gluten, 2·93; also resinous coloring matter, 0·55; yellow extractive with tannin and salts (nitre and the chlorides of potassium and calcium), 1·91; sweet extractive with malic acid; and some salts, 10·88.

"The condensed mucus, which abounds in the testa of the seed, is readily acted on by hot water, and a viscid mucilaginous fluid is formed, in which are two distinct substances; one completely soluble in water, analogous to common gum, called Arabine by chemists; the other portion is merely suspended, and is considered to be analogous to the Bassorine, found chiefly in gum Bussoora, and in cherry-tree gum. Alcohol produces a white flaky, and acetate of lead, a dense precipitate in mucilage of linseed.

"Linseed oil, which we have seen, is contained in the kernel of the seeds, is obtained by expression, and may be either cold-drawn, or, as usually obtained, after the seeds have been subjected to a heat of 200°. The former, as in the case of cold-drawn castor oil, is paler, with less color and taste than linseed oil prepared with the aid of heat. This is of a deep yellow or brownish color, of a disagreeable smell and taste; specific gravity 0·932, soluble in alcohol and ether; differing from many other fatty oils, especially in its property of drying into a hard transparent varnish—a peculiarity which is increased by boiling the oil, either alone, or with some of the preparations of lead.

"The yield of oil from a bushel of East Indian seed is 14¾ lbs. to 16 lbs.; of Egyptian, 15 lbs.; of Sicilian, 14½ to 15½ lbs.; of Russian, 11 lbs. to 13 lbs.; of English or Irish, 10¾ lbs. to 12 lbs.

"Linseed oil, according to SAGE, is composed of Margarine and Oleine in nearly equal proportions. But the oleic acid of linseed differs from that of other fatty bodies. The anhydrous acid is composed of carbon, 46; hydrogen, 38; oxygen, 5. The margaric acid is as usual composed of carbon, 34; hydrogen, 33; oxygen, 3. The glycerine obtainable from linseed oil in large quantities, is also similar to that procured from other fats.

"The seeds, after having had the oil expressed from them, are in the form of a flat mass, commonly called oil-cake. This being reduced to coarse powder, forms the linseed meal which is so commonly employed for making poultices, though these are also formed of the simply powdered seeds. Here, it is evident, from the internal oleaginous and external mucilaginous parts being all ground together, and their properties elicited by hot water, an admirable mixture is produced for making a readily made emollient poultice. From the chemical composition, it is also evident how nourishing the linseed is likely to be, and, indeed, from experience is well known to be, for fattening cattle."

1625.—Castor oil (*Ricinus communis*). *Vern.* — Arind ka tél; harind; bedanjír (Pers.); harnauli (the seed).

The native method of preparing the oil is very defective, always resulting in a thick semi-transparent oil, or else of a dark thick oil worse than the first; it is prepared either by simply pressing the seeds, or else by roughly bruising them, and then boiling in water, which latter process gives a purer oil. Sometimes the nuts are partially roasted over a charcoal fire, and then bruised—this often discolors the oil.

The oil is good for burning; but is chiefly valued as a safe and efficient purgative. The pulp of the crushed seeds is applied locally as a poultice in dracunculus (guinea worm). Samples were sent from—

(2550) Delhi.
(2623) Sirsa.
(2684) Ambálah.
(2863) Kangra (this is a remarkably small variety).
(2925) Hushyarpúr.
(2926) Amritsar.
(3150) Lahore.
(3195) Rawalpindi.
(3223) Gujrát.
(3302) Gugaira.

There are two methods in use for extracting the oil from the seeds—1st, by pressure, which is the ordinary method; and 2ndly, by bruising the seeds, and afterwards boiling them in water. The oil floats on the surface, and is skimmed off. This method is employed when a purer oil is required.

The oil is only exhibited from Kangra, Amritsar, Gujrát and Lahore; which latter place exhibited for comparison a sample of European cold-drawn castor oil.

1626.—Poppy oil, khashkásh.

There are two varieties of seed,—white and "black" (or rather blue-gray color)—they yield an oil precisely similar. This oil is singularly clear. When fresh it is like olive oil, which it is largely used to adulterate in Europe. It is an excellent drying oil for the painter, and possesses the remarkable property of becoming colorless by simply exposing it for some days to the sunlight. The oil is obtained by pressure. The seed is sent from—

(2683) Ambálah.
(2866-2868) Kangra.
(2919) Hushyarpúr.
(3010) Amritsar (black).
(3111) Amritsar (white).

(3135) Chúníáń, Lahore district (of two colors).
(3231) Gujrát (white).
(3232) Gujrát (black).
(3300) Gugaira.
(3373) Dera Ismaíl Khán.
(3498) Srínagar.
(3499) Jammú (of the 2nd kind).

Samples of poppy oil were exhibited from Kaıigra, Amritsar, Lahore, Shahpúr and Dera Ghází Khán.

1627.—Kussumbha, safflower seed oil. *Vern.*—Poliyán (wild variety); karar; ma'sufir (Pers.); the bastard saffron or safflower (*Carthamus tinctorius*).

There are two seeds—one the cultivated, is white and glossy; the other (karar) is a smaller but similarly shaped seed, mottled or dusted, brown-gray and white; both yield oil. The oil is clear yellow; is esculent: and would be peculiarly suitable for burning in lamps, on account of the little heat which it gives out. It deserves to be more generally cultivated than it is. The flower yields the well known dye. (*See* Sub-class (C)., Dyes).

Samples of the seed were sent from—
(2556) Delhi.
(2565) Gurgaon.
(3051) Amritsar.
(3145) Lahore.
(3200) Rawalpindi.
(3733) Gujrát (karar).
(2680) Ambálah.
(3144) Lahore.

The oil was exhibited from Kangra, Hushyarpúr, Amritsar, Lahore, Gujrát and Jhínd.

1628.—[4240]. Oil of almonds, (*Amygdalus vulgaris*). *Vern.*—Raughan-i-bádám. Lahore.

A sample is also sent from Amritsar (4212), and Dera Ghází Khán (4410).

This is an expensive article, selling as high as 13 Rs. a seer. It is expressed only in small quantities by means of a small screw press, and is used in medicine.

The almonds are imported from the Persian Gulf. There is also the oil of bitter almonds, "raughan-badam-talkh," used exclusively in medicine.

1629.—[ ]. Oil of apricot kernels, "raughan-i-maghz-i-khubáni."

This is principally a hill produce near Simla, and near Kanawár, as also near Kangra. The kernels and stones of the apricot form an article of export to the plains, under the name of "sarí."

Samples of the stones are ent both from Kangra and from Simla, and the oil (4181) Simla and (4193) Kangra. A clear amber yellow oil. In Lahore this oil is used. Principally being imported from Kúlú, but none is produced in Lahaul; also mustard and poppy oil are occasionally brought in.

1630.—[4196]. Walnut oil, "raughan-i-akhrot." Kangra.

A clear serviceable oil of a pale yellow color.

1631.—[ ]. "Baikar," oil of *Prinsepia utilis*. Kangra.

This is the only specimen exhibited.

1632.—[4190]. Mowa oil and kernels. Kangra.

The oil of the kernels of *Bassia latifolia*.

"The seeds yield by expression a large quantity of concrete oil, which is used in lamps, to adulterate ghí, for frying cakes, &c. The kernels are easily extracted from the smooth chesnut colored pericarps when they are bruised, rubbed, and subjected to a moderate pressure. The oil concretes immediately it is expressed, and retains its consistency at the temperature of 95°. The oil is however thick and coarse, and only used by the poorer classes.

"It is said that the flowers are eaten fresh as a vegetable, and that an ardent spirit is distilled from them.

"In Gujrát and Rájputána every village has its spirit shop for the sale of the distilled liquor from the flowers. In the island of Caranja, opposite to Bombay, the Government duty on the spirit distilled (chiefly from this flower) amounts to at least £60,000 per annum; I rather think that £80,000 is most generally the sum."*

In Kangra district, the following particulars are recorded by BARNES, in his Settlement Report.†

"The 'mowa' or *Bassia longifolia*, is widely diffused over the lower hills. In parts of perganah Núrpúr it exists in great abundance, and the two small taloquas of upper and lower Mow, derive their name from the prevalence of the tree. It is well known in our lower provinces. A spiritous liquor is drawn by distillation from its flowers; and a thick oil, adapted for the manufacture of candles, is expressed from the seed. The flowers are collected as they fall from the tree, in May, and are sold by

* DRURY'S "Useful Plants of India."
† Kangra District, para. 149.

the people to the "kulál" or distiller, at the rate of fifty seers for the rupee. The flowers are immersed in water. The fourth day they are fermented and the process of distillation begins. The people burn the oil for lamps, and traders sometimes use it to adulterate the ghí (or clarified butter) intended for exportation."

1633.—Butter from the *Bassia Butyracea* of Kamaon. DR. W. JAMESON.

Together with a sample of the seed producing this vegetable tallow. The butter itself is in little round pieces, quite white, smooth and firm: it becomes quite liquid by warming. MAJOR DRURY describes it thus:—"DR. ROXBURGH has fully described in the 8th Vol. of the 'Asiatic Researches.' The kernels of the fruit are bruised into the consistence of cream, which is then put into a cloth bag with a moderate weight laid upon it, and left to stand till the oil or fat is expressed, which becomes immediately of the consistence of hog's lard, and is of a delicate white color. Its uses in medicine, are much esteemed in rheumatism and contractions of the limbs. The pulp of the fruit is eatable. The juice is extracted from the flowers and made into sugar by the natives. It is sold in the Calcutta bazar, and has all the appearance of date sugar, to which it is equal if not superior in quality. The butter which is obtained from the kernels of the fruit is reckoned a valuable preservative when applied to the hair, mixed with sweet scented oil, and thus sold and exported." A sample was sent to England for analysis, and was found to consist of 34 of fluid oil, and 6 parts of vegetable impurities.* The original specimen dissolved readily in warm alcohol, a property which may render it of great advantage in medicinal purposes. It makes excellent soap. When pure it burns bright without smoke or smell, and might be advantageously employed in making candles.

It is a peculiar characteristic of the seeds of the *Bassia* trees, that they contain at the same time saccharine matter, spirit and oil, fit both for food and burning in lamps. The butter procured from this species of *Bassia* is not liable to become rancid, even if kept for some time. It is completely melted at a temperature of 120°, but retains its consistency up to 95°.

The tree is abundant in the Almorah hills, where the butter is called "palwa" or "phalwara." It flowers in January, and the fruit ripens in August. The butter is highly esteemed as a liniament in rheumatism, contraction of the limbs; and is an excellent emollient for chapped hands, &c., &c., during the winter months.

1634.—[ ]. Vegetable tallow (*Stillingia sebifera*). Kamaon. DR. W. JAMESON.

This sample consisted of a large cylindrical mass of white and solid tallow, very pure and inodorous. There was also a sample of the white kernels from which the tallow is obtained.

Efforts have been made from time to time to introduce this tree into the Punjab; it has succeeded at Kangra, and there are trees at Lahore, Amritsar and Sealkot, and other places. The Financial Commissioner, in his Revenue Report for 1862-63, writes:—

"The China tallow tree, or *Stillingia sebifera*, has seeded this year for the first time both at Amritsar and Lahore. It has been yielding seed at Holta for some years past; but nowhere else in the Punjab. During the last two or three years, the liberal supplies sent to us by DR. JAMESON, have been sown in all parts of the Punjab, so that in a few years more, there is little doubt that the tallow and oil from this tree will be produced in considerable quantities, and become articles of importance." The tree appears to grow with great vigor wherever it has been planted, both here and in China."

1635.—[4213]. Oil of the seeds of the gourd, kadú. Amritsar.

A sample was sent from Lahore also (4243).

1636.—[4245]. Oil of water melon seeds (*Cucurbita citrullus*), kharbúz. Lahore.

1637.— [3244]. Oil of cucumber seed, "tukhm-i-khyár." Lahore.

1638.—[4241]. Oil of lettuce seed, "raughan-i-kahu." Lahore.

1639.—[2927]. Seeds and oil of "rám torái." (*Luffa sp———?*)

1640.—[4251]. Oil of cotton seed, "raughan-i-banaula." Lahore.

1641.—[4335]. Oil of turnip seed.

A sample is sent from Dera Ghází Khán (4403).

1642.—[4239]. Cocoa nut oil. Lahore.

This is made from imported cocoa nuts; it is quite uncommon, and used for medicinal purposes.

* ROYLE'S Illustrations, p. 263.

1643.—[4239]. The seeds of the *Moringa pterygosperma*. Hushyarpúr.

But there is no sample of the oil. It is this tree which used to yield the Ben oil, prized by clock-makers; the seeds and seed vessels while green, are eaten pickled by the natives.

1644.—[4229]. Purified lamp oil. Prepared at the Sealkot Mission Industrial School.

This is the gingelly or sesamum oil, purified by agitation in sulphuric acid; the acid seizes on, and turns black all vegetable particles in the oil; when the acid is poured off, the oil is repeatedly agitated with water, and then left to settle. The charred vegetable impurities soon subside, and the clear oil is poured off as it floats on the surface of the water.

1645.—[4197]. Deodar oil. *Vern.*—Chilóñ; deár ka tal, from Kúlú. KANGRA LOCAL COMMITTEE.

This is a dark strong smelling oil, of powerful antiseptic properties: it is of the nature of a wood oil, and between an oleo-resin and a true oil.

Oil from the seeds of the deodar cones—with a sample of the seeds.

A very fine sample was sent by DR. JAMESON.

1646.—[ ]. Cedar oil.

This is a thick oily liquid with an empyreumatic odor, which, when allowed to rest, deposits a white flocculent sediment; its specific gravity is 987, when distilled it first gives off water with a little acetic acid, and then a clear yellow oil, specific gravity 965, and leaves in the retort a black resinous mass which solidifies in the cold into a black brittle solid. The yellow oil is a volatile oil with a faint pleasant smell, insoluble in distilled water, but soluble in alcohol or ether. It is turned black by sulphuric acid; with nitric acid in small quantity, it dissolves in water, but if the quantity is increased it is powerfully decomposed, forming a red thick solid. If cooled to the temperature of 10° it does not solidify, but becomes opaque. It burns with a very smoky flame.

The black resin is partly soluble in cold alcohol, partly in boiling alcohol. It is also very soluble in solution of potash; and if hydrochloric acid is added to this, the resin is precipitated in white crystals, which are combustible.

The oil therefore resembles crude turpentine, and the essential oil is somewhat similar to oil of turpentine, but has different odor, it is likely to be useful in those affections, such as rheumatism, hœmorrhage and cholic, in which oil of turpentine is employed.

1647.—[4218]. Pine oil, "raughan-i-chíl." Amritsar.

A sample was sent from Lahore (4242). This was in properties and appearance very like the foregoing.

MEDICINAL OILS.

These consist either of oils, expressed from rare substances, or else are refined sesamum oil medicated with various herbs.

1648.—[4405]. Narúl ka tel. Dera Ghází Khán.

A dark colored and very offensive smelling oil, said to be a medicine for the eyes. The maker will not disclose its contents. It is obviously a compound; the name "narúl" is not to be mistaken for "narel" cocoa-nut.

The following is a list of the rarer oils, and medicated oils used in native medicine. They were prepared by RAM SING of Lahore, under direction of the exhibitor, HURSUKH RAI. A few of them were sent from Amritsar.

The medicated oils expressed from uncommon materials are—

Soap nut—*Sapindus emarginatus*—retá. The black kernels are sent from Lahore (3149); but there is no sample of the oil obtained from them.

Walnut.—*Juglans regia*—akhrot.

Marking nut—*Anacardium semicarpus*—bhiládar (black, acrid and poisonous).

Cashew nut—*A. orientale*—hijli bádám.

Olive—*O. europea*—raughan-i-zait.

——— *Celastrus paniculatus*—mál kangani. Samples also were from Amritsar (4214) and Kangra (4196). A dark red oil, powerfully stimulant.

Large cardamoms—*Amomum cardamomum*—iláchi bari (the essential oil).

Smaller ditto—*Elettaria cardamomum*—iláchi choti.

Cloves—*Eugenia caryophyllata*—laung.

Cinnamon—*Laurus cinamomum*—dar chiní. This is of European manufacture.

Nim seeds.—*Azadirachta indica*—nim. An acrid oil extracted from the pericarp of the seeds; its properties are stimulant and anthelmintic; it is used also in leprosy.

Myrtle berries — *Myrtus communis* — hab-ul-ás.

Said to be very strengthening and promotive of the growth of the hair.

Mace—*Myristica moschata*—jauntari.

Cubebs oil—*Piper cubeba*—Kabáb chiní.

Melon seeds—*Cucurbita pepo*—kharbúza.

Anise seed—*Pimpinella anisum*—anísun.

Fennel seeds—*Nigella sativa*—káli zírí.

Khas khas root—*Andropogon muricatum*—khas.

Pistachio nut—*Pistacia lentiscus (cabulica)*—pistá.

Edible pine seeds—*Pinus Gerardiana*—neoza chilghoza.

Oil of dill seed—*Anethum graveolens*— soáf.

Oil of onion seed—*Allium cepa*—piyáz.

Oil of wild onion—*Scilla sp*——? pyáz jangli.

Beleric myrabolan—*Terminalia bellerica*—halela.

Bakhain berries—*Melia sempervirens. Vern.*—Bakhain ; darkona ; hab-ul-ban.

Nutmegs—*Myristica moschatta*—jaiphal.

Spinach seed—*Spinacea oleracea*—bíj pálak.

Cabbage seed—*Brassica*—karm.

Seeds of wild rue—*Peganum harmala*—harmal.

Quince seed—*Cydonia vulgaris*—safarjal.

Hemp seed—*Cannabis sativa*—bhang. A sample was also sent from Kangra.

Amaranth—*Amaranthus sp*——?—chulaí, &c.

"Raughan-i-jauz" mukaddar (bankor). Given as a medicine for horses.

Cummin seed—*Cuminum cyminum*—zíra.

Croton oil—*Croton tiglium*—jamálgota. Samples of the nuts were sent both from Lahore and Amritsar.

Of the medicated oils there is first a series medicated with gum resins and resins.

Raughan-i-balsán.

„ lubán (*Benzoin*).

„ sundras (*Vaterica indica*).

„ rál (*Shorea robusta*).

„ baroza (*Pinus longifolia*).

„ gúgal (*Amyris agallocha*).

„ mustagi—mastic.

„ anzarút (*Penæa sarcocolla*).

The medicated herb oils are—

Raughan-i-babuna—camomile.

„ dhatúra—datura.

„ raihán—(*Ocymum pilosum*).

„ sázajín (two kind of "sázaj.")

„ kápúr—camphor.

„ ratanjot—alkanet (*Anchusa tinctoria*).

„ afsantín—wormwood (*Artemisia*).

„ chobchíní (*Smilax china*).

„ banafsha (*Viola serpens*).

„ anjabár (*Poloygonum bistorta*).

„ zambak (*Amaryllis sp*———?)

Useful for earache. The plant is an *Amaryllis*, with thick fleshy stalk, and several flower heads on the crown.

Raughan-i-hana (*Lawsonia alba*).

„ bedmushk (*Salix Ægyptiaca*).

„ kachúr (*Curcuma zerumbet*).

„ samb-ul-tib (*Nardastachys jatamansi*).

„ aklel-ul-mulk (*Calendula officinalis*).

„ izkhar—flower of (*A. muricatum*).

„ kust—root oil. (Amritsar).

„ sosan.

„ asárán (*Asarabacca*).

„ bach (*Cyperus longus.*)

„ parsiawshán (*Adiantum V. capilli*).

Raughan-i-anjedán.

„ gauzabán.

„ anjírá zard.

„ sír.

„ nirmasi.

„ tírí.

„ kaner (*Oleander*).

„ zafrán—saffron.

„ surinján talkh (*Colchicum*).

„ gul-i-lála—tulip flower.

„ shísham (*Dalbergia sissu*).

„ 'ud-us-sálap.

„ filful (*Piper nigrum*).

„ farásiyún.

„ brinj ásaf.

„ vasma (*Indigofera tinctoria*).

„ marzanjosh—marjoram (*Origanum vulgare*).

Raughan-i-farinj mushk (*Ocymum sp.*——?)

„ krishna (*O. sanctum*).

SCENTED OILS AND ATTARS.

The scented oils included 1st, pure tíl or gingelly oils, scented with the flowers of roses, &c.; and, 2nd, attars (*properly 'atr or 'itr.*)

Of the first kind there are—

1649.—[4209]. Raughan-i-gul, rose scented oil. Amritsar.

And (4301) Lahore.

1650. [4215-4216]. Raughan-i-motya and chambelí, jessamine (*J. zambac* and *grandiflora*).

(4300-4303-4305) Lahore.

1651.—[ ]. Raughan-i-rabel, jessamine (*Jasminum sp.*———). Lahore.

1652.—[4217]. Raughan-i-karna, orange flower.

(4268-4299) Lahore.

1653.—[4253]. Raughan-i-majmúa, compound scented oil. Lahore.

The scents from this are "chalchalira," "samb-ultib," "kachúr," &c., &c., all mixed in a "pot pourri."

1654.—[4232]. "Tel Multání," scented oil. Lahore.

Like "karna," or orange flower oil.

1655.—[ ]. Sandal wood oil. Lahore.

'Atrs are very strong oils, containing the essential oils of the plants and substances used in their preparation; a few drops are sufficient to produce a perfume which is perfectly overpowering, and produces a headache. The natives have the phrase in their language—"dímágh *mu'attar* hona"—to be stupified with fragrance. These attars are principally made in Hindústán, but also at Amritsar and Delhi.

1656.—[ ]. The following is a series from Lahore.

Attar of keora—atr-i-keora—from the flowers of *Pandanus odoratissimus.*

Attar of jessamine—atr-rábel—*Jasminum zambac.*

Attar of double jessamine—atr-chambelí—*J. laurifolium.*

Attar of tuberose—gul-i-shub-bo—from the flowers of *Polyanthes tuberosa.*

Attar of willow flowers—bed-mushk.

Attar of the spring—atr-i-bahár—fancy scent.

Attar of compound essences—'atr-i-majmúa—composed of several kinds of attar.

'Atr pánrí.

'Atr gil (perfume of clay)—this atr-gil is not to be confounded with atr-gil, or otto of roses.

Attar of hena—atr-hanná—flowers of *Lawsonia alba.*

Attar of musk—atr-mushk, scented with musk of the Thibet musk-deer.

Attar of khas, of the khas grass root (*A. muricatum*).

Attar of ambergris—atr-i-'ambar—scented with ambergris.

Attar of jessamine—atr-i-motiya—*Jasminum sp*—.

Attar of roses—'atr-gul—Persian roses.

Atr-i-maulsírí.

A further series from Delhi contained, besides the above:—

'Atr ketgí.

'Atr júí.

'Atr madan mán.

I have no information as to the composition of these latter.

Some of these attars are much adulterated by the admixture of plain oil. Properly speaking they consist of the strong volatile oil from the petals of the highly scented flowers—rose, jessamine, &c.—which yield them. They command a very high price, and many of them, such as "keora," "maulsirí," "panrí," being prepared from flowers which do not grow in the Punjab, are imported from Hindústán. These attars are much used by the wealthier classes of natives to perfume themselves.

As an appendix to this class, it is desirable to reproduce the following "Memo. on the Manufacture of Attar, or Otto of Roses," which appeared in a recent paper of the Proceedings of the Agri-Horticultural Society of the Punjab. The process described is equably applicable to other attars—the proper kind of flower being substituted for the rose leaves.

The following sketch of the method by which the attar of roses is prepared at Lahore was drawn up after an inspection of the apparatus and method of proceeding employed at one of the largest establishments in the city.

1*st.*—*Flowers employed.*—The petals of the ordinary country rose are generally used (*Rosa centifolia*), and occasionally those of the "baramasa," but these are only half the value of the first-mentioned sort, no other kind is found to produce so much, or so good an, essential oil.

Of these kinds of roses, the native druggist believes that about 1,000 maunds of flowers are used annually at Lahore and Amritsar, for the purpose of distilling, the price of each maund being from 2 to 3 rupees, according to the season and quality.

The rose petals are used as fresh as possible, and are first carefully picked to remove any dirt, and also stalks, calyx and stamens.

The Apparatus used.—1st.—A large copper degchí with a wide mouth, and the body sufficiently capacious to hold 4 maunds of water.

2nd.—An earthern flat gamlah employed as a lid; this is perforated with a hole to admit.

3rd.—A bamboo pipe joined to the mouth at right angles, perforated throughout its whole length and secured with a string.

4th.—A long copper vessel, with a narrow neck, into which the bamboo pipe is thrust and plugged with cloth. The vessel is put into a cistern and surrounded with cold water.

5th.—A degchí with a broad mouth.

6th.—A bottle.

7th.—A tin cup.

Quantities used.—Twenty maunds of picked rose leaves, one maund of water, 50 tolahs of *chandan* (oil of sandal wood, *Pterocarpus santalinus*).

Process.—One maund of rose leaves and ½ a maund of water is put into the first degchí, and the cover and tub fixed on with clay, the other end of the bamboo pipe is inserted into the long-necked vessel No. 3, into which 50 tolahs of sandal wood oil is placed, and this vessel is set in the cistern full of cold water. Heat is applied to the bottom of the first degchí until 10 seers of water are distilled over into the sandal wood oil, carrying with them about 3 mashas of genuine attar of rose, which is dissolved by the sandal wood oil.

The apparatus is then taken to pieces, and the rose leaves thrown away. The mixed oil and distilled water are poured into the degchí No. 5, and allowed to stand for some time. The oil rises to the surface of the water, and is separated by a singular but rude process. The operator dips his naked hand flat on the oil which adheres to the skin and prevents the water wetting it, he then raises his hand and scrapes it on the side of a tin vessel into which the oil falls; and is thence poured into a bottle. This process is repeated till all the oil is separated from the water. Then the process is recommenced, the oil is poured into the vessel No. 5, and the water with one maund of fresh rose leaves into the degchí No. 1, and the distillation recommenced and carried on in the same way as before.

This process is repeated for twenty days, and though the druggist considers that 3 mashas of pure attar of rose are distilled every day, yet by the clumsy process of separating the oil and water, so much is lost, that, though 5 tolahs of attar are added to the 50 tolahs of sandal wood oil, yet only 50 tolahs are produced at the end of the process; so that 1 part in 10, is wasted.

The product sells for its weight in silver, each tolah weight selling for one rupee.

SUBSTANCES MANUFACTURED FROM OIL.

SOAPS.

1657.—[1602]. Bars of soap, and cakes of "Windsor" soap. Sealkot. Mr. W. Spence.

4 annas per lb.; cakes, 1 anna each.

1658.—[1604-25]. Family soap and saddle soap, in bars. Sealkot Mission Industrial School. Rev. A. Gordon.

8 annas per bar.

The Superintendent writes as follows :—

"The Industrial School is yet in its infancy. It has been struggling along without capital and without apparatus, except of a very limited character. Its object is to furnish employment to Native Christians and inquirers, and thus eventually to constitute a self-supporting and productive community. Without something of this kind Native Christians of the uneducated classes are but drones on society—not from any fault of their own, but from the nature of the case : cast off as they are from their own communities, and without employment in their new relations.

"Soap is the article on which we have, as yet, spent the most effort. With our present apparatus we can turn out three or four hundred bars a month. The substances used in the manufacture are chiefly fatty matters combined with alkalies. The combining power is heat. After combination it is purified and cast into wells. After hardening it is cut into bars and stamped by machinery, invented and made by ourselves.

"The turpentine exhibited in Sub-class (A.) is distilled by a double refining process, from "gunda-baroza." We can with our present apparatus turn out three or four dozen bottles per month. But there is much difficulty in getting a constant supply of the raw material. It comes from the hills, and very little used by natives except as a medicine, and in one or two trades. There is not a sufficient general demand to ensure a continuous and plentiful supply.

"The lamp-oil is purified by a chemical process, combined with time. The object of the process is to remove all resinous and other foreign matters from the oil, and leave it in its pure state. The extent to which this process is carried on, within certain limits, is regulated by the demand. We are prepared to purify several maunds monthly, provided the market justify us in so doing."

1659.—[ ]. Common soap. Lahore.

This is a coarse soap made in moulds consisting of earthen basons. The fatty substance is rape or "sarson" oil, and the alkali "sajjí," which are heated together with lime.

1660.—[2168]. Soap. Gujranwallá. Local Committee.

This is in round convex pieces, of three colors—opaque white, brown and pink—the latter color being produced by the addition of "kusumbha" (*Carthamus tinctorius*).

1661.—[2188]. Soap. Gujrát. Local Committee.

Price 4 seers per rupee.

Made generally from oil extracted from "til" and "sarson" seeds, and sometimes sheep's fat is used. One maund and 20 seers of "sajjí" (carbonate of soda) are mixed with about 20 seers of lime, and a small quantity of water is added to the mixture, until it becomes of the consistence of paste or dough. A solution is then made by adding water to the mixture and filtrating several times, and each time pouring the filtrate over the undissolved residue. The solution is then added gradually to 4 maunds of oil and the whole well stirred. After standing for some time the solution is boiled, the superfluous oil rises to the surface and is skimmed off, the soap becomes insoluble; and, when in a half melted state, is drawn off into moulds, and on cooling is ready for use.

Soap was sent also from Jhang Jail (1019-1021); and from Shahpúr (2227); and from Gugaira (2228).

For finer washing and dyeing purposes, the skin or shell surrounding the seeds of the soap-nut tree (*Sapindus emarginatus*) is often used. When mixed up with warm water a fine lather is soon produced, and the most delicate fabric may be washed, and even silks, without destroying the color, which would yield to a coarse alkaline soap. The nuts are produced in parts of the hills, and are called "ritha" or "haríta." These nuts contain the principle termed Saponine. Several species have in their bark and roots saponaceous properties. "The exact nature of the principle," says Dr. Royle.* "might be advantageously investigated by chemists favorably situated in the native countries of the plants; and the nature of the changes ascertained which takes place, from the unripe and acrid, to the bland and saponaceous ripe fruit.

S. emarginatus, acuminatus, detergens and *laurifolius*, all bear saponaceous fruits.

* Illustrations, p. 138.

REPORT ON OILS AND OIL SEEDS.

CLASS IV. SUB-CLASS (B).

THE JURY CONSISTED OF THE FOLLOWING GENTLEMEN :—

MR. R. H. DAVIES,
MR. R. E. EGERTON,
MUNSHI HARSUKH RAI,
MR. F. E. GORDON,
SIRDAR JASSA SING *of Amristar*.
DR. BROWN (*Chemical Examiner*).

REPORTER—MR. BADEN POWELL.

IT is scarcely necessary to remark on the great importance of this Class, which contains oils and the seeds from which oil can be expressed. There is, perhaps, hardly any product of the vegetable kingdom of such universal utility as oil. 1st, There is the important quality which renders oil a necessity by its combustibility. Next, many kinds of oil are esculent, they are used in cooking, and in cold climates are eaten, with satisfaction, as yielding the large supply of carbon, so necessary for the support of life under excessive cold. As medicines, some of them form valuable aperients, which produce their effect without at the same time injuring the structural tissues of the stomach and intestines; others are valuable as stimulant and vesicating agents; or are powerfully drastic and valuable as a last resort, like the oil of croton; while many other oils form the basis of emulsions and linaments, and are useful for local applications, as for instance, sweet oil in burns. In the arts, besides the immense value of oils as lubricating agents for machinery, they are indispensable to the painter, especially when converted into drying oils; they also form with mastic, copal, &c., valuable varnishes both to the artist, the furniture maker, and the carriage builder.

No wonder then with these and many other uses, oils and oil seeds should be important articles of commerce.

In the Punjab there is a good deal of internal trade in oils, which are carried about in "kuppas," large jars, formed of intestinal tissue, which is boiled into a glutinous mass and then formed over solid clay blocks into the shape desired. When dry, the clay block is crushed and the pieces taken out, leaving a hard hollow vessel. Not a little oil and oil seed, especially "sarson" and sesamum, pass on to Bombay by the Indus and other routes. It is to be regretted that there are no exact returns of the exports of oil and oil seeds for the Punjab itself.

To give some idea of the value of the trade in oil seeds, and the great increase observable in it of late years, I extract a passage from the "Edinburgh Review" for January 1864.*

"Within the last 25 years several articles of great commercial value have been added to the exports from India.

* No. 243, p. 102.

"Of these the chief are—oil seeds, jute, wood, coffee and tea. The following statement will show how from a small beginning the trade in these products, has rapidly grown into importance * * * In 1842 the exports of oil seeds from India valued at £2,377; in 1852, it was £501,420; and in 1862, £1,129,469!

"The case of oil seeds is peculiar: up to the time of the Russian war, which shut out England from her accustomed source of supply, the increase of exportation, although large, appeared to have reached its limit, since during the three years ending with 1854, the value of shipments had been stationary;-in 1854 it was only £471,797, or somewhat less than in 1852. But the demand resulting from the exclusion of the supply from Russia raised the value in 1855 to £812,799, and in 1856 to £1,273,457, showing how capable India is of responding effectually even to a sudden call, backed by a sufficient price. The value of the exports in 1862 is considerably under the average of the last 7 years, which is £1,480,470."

There is further, with this class of articles no difficulty of cultivation, nor apprehension of extensive failures, as must necessarily be the case with tea, cotton, flax, &c. On looking at the collection of oil seeds, and noting the number of districts producing any one of them, it cannot fail to strike our attention, how little difficulty must attend the cultivation of most of them. Take the common "sarsoń" for instance—we find this seed grown all over the province, from the inhospitable wilds of the Spiti valley, to the hot plains of Delhi—and and there is scarcely a shade of difference observable between any two samples from any district between these limits that one may choose to examine.

Sesamum, again, is exhibited from the lower hill states of Simla, as well as from Gugaira and from Jhínd, and the same with linseed and poppy seed, and one or two others.

It is precisely these common and widely distributed oil seeds that are the most valuble in trade. The oils produced by *Bassia*, *Prinsepia*, *Armeniaca* and *Anacardium*, and some others, are comparatively local—and at present, at all events, unimportant—though in the case of the vegetable tallows of *Bassia* and *Stillingia*, it is impossible to predict what may not be their future commercial importance when the trees producing them shall have become universally cultivated, and the methods of extracting the beautiful white tallow they yield, well known and cheaply practised.

Another point calls also for remark; viz., the great number of plants yielding oil, and the perpetual increase of the number, as year by year, it is observed that plants are added to the lists of oil producers, whose properties of this class were previously unnoticed. All oils may be divided into various classes,—distinguished by certain characteristics, upon which their value in art or medicine depends.

There are the vegetable fixed oils—such as mustard, rape, linseed, &c. Some of these are distinguished by the property of more readily *drying* than others. This gives them great value in the eyes of the painter and of the maker of printing inks. Poppy oil, linseed, and hemp seed oil, have all these properties. They are much increased by boiling the oils, to reduce their bulk to about one half, this is done in preparing printing ink; or the oil is boiled with a due proportion of acetate of lead, and this furnishes an oil highly prized by the artist. The theory of preparing the drying oil is to deprive it of all mucilage which it naturally contains. The basic acetate of lead effects this better than almost anything else, as it combines with the mucilage, which is thrown down as a sediment; the older the oil is, the better for this purpose. Others of these fixed oils possess the property of remarkable limpidity, rendering them valuable as lubricating agents for machinery, &c.

The ben oil, used by watch-makers, is of this nature; as is also the sandal wood oil, and what is called Macassar oil. But all these fixed vegetable oils possess the property of leaving a permanent greasy mark or stain upon paper, which distinguishes them from the *volatile* oils, which do not. Some of these fixed vegetable oils are of great value in

medicine, such as the castor oil, croton oil, marking nut oil ("bhiládar"), &c.; oil of black cummin *(Vernonia anthelmintica)* being either internally purgative and drastic, and externally emollient; or else, as in the case of croton and "bhiládar" oil, vesicating and excitant.

These fixed or fat oils are derived either from vegetable or animal sources, and consist chemically of stearine and elain,* the former being the solid, the latter the liquid, portions; or still further proximately, of stearic acid, margaric acid, oleic acid and glycerine.

It is the first of these, that is the solid element, on which depends the value of an oil or fat for making candles. Margaric acid and the glycerine are of importance in oil for soap-making; and oleic acid in burning oils. The art of separating and obtaining pure and colorless glycerine is almost of recent introduction into Europe, and now pure glycerine is converted into a translucent soap of beautiful appearance, while colorless glycerine is a valuable emollient for application to chapped and rough skin.

The other class of oils are called *volatile* oils. They are generally of a somewhat limpid quality—do not leave a permanent stain as fixed oils do, are generally highly scented, and always strong tasted—they are valued either in perfumery or in medicine, or in both, according to their fragrance. This class includes what are called essential oils. To this class also belong all the attars, which will be noticed presently.

A third class, somewhat poorly represented in the Punjab, includes wood oils, being of the nature of an oil combined with liquid resin and pyroligneous principle, such as the wood varnish of Silhet, and the deodar and "chíl" oils of the Kohistán.

A fourth class includes the petroleum, or earth oil.

From the foregoing considerations, it will be easy to determine not only the class to which an oil belongs, but from a slight chemical examination to surmise the particular value it will have in art, manufacture or medicine.

In the Madras Jury Reports for 1855, there is in the report on oils a portion of a letter from G. F. Wilson, Esq., to Sir W. Hooker, Royal Gardens, Kew, which is valuable, as indicating the method of judging of oils, so as to determine their probable value. As the original report may not be very accessible to my readers, I have extracted at length. The letter runs as follows:—

"Every oil, or grease, whether solid or liquid, if not poisonous or acrid, like croton oil; or viscid and gummy, like castor-oil; or drying, like linseed oil; must be worth in London at least £30 a ton. Among greases solid at above 60° Fahrenheit, the higher the melting point (other things equal), the greater the value: for example, the vegetable tallow of Borneo melting at about 90° Fahrenheit, is worth at least £5 a ton more than the cocoa nut oil of Ceylon, melting at 70°. The effect of the soap duty having been taken off, may probably before long, materially change the relative values of greases; but, at present, liquid oils, like the ground nut (*Arachis hypogea*) are worth more than soft solid oils, like the *Bassia* butter of India, as they require less manufacturing to fit them for use; the liquid oils after a simple treatment in a cheap apparatus, being fit for burning in lamps, while the soft solid oils being neither hard enough for use in candles, or liquid enough for use in lamps, require to go through a press before they are saleable, except for soap-making. Greases may have particular advantages, such as being little acted upon by the air and therefore not easily becoming rancid, but these good qualities can only be ascertained by experiment, which your correspondents had perhaps better leave to us.

"We have been engaged in some experiments upon oils, for use in medicine, in which it seems probable they will take an important place; already one vegetable oil has been found to be almost as efficacious as cod liver oil, with the advantages of being less unpleasant and cheaper. On account of this new use, it might

* *See* Brande and Ure, *ad loc.*

be well to collect small quantities of oils, even if they did not obey the conditions mentioned above. The value of oil must depend a little (especially when found in out of the way places) upon the way it is held in its matrix; for example, the oil of the 'lumbang' nut (*Aleurites triloba*) can be separated with much less labor and simpler machinery than the cocoa nut oil, which requires very great pressure to extract it from the 'copperah,' or dried cocoa nut kernel.

"Waxes are worth more than greases, on account of their very high melting points; their relative values depend upon color, transparency, and freedom from resinous matter. Resin may be easily detected by lighting a small piece of the wax; the more smoke, the greater proportion of resin, and therefore less value; the paler and more transparent the wax the better. The most valuable tree wax known, is the beautiful insect wax of China.

"A simple way to try an oil nut, is to crush it with a stone, and then squeeze it between your finger and thumb; if it contains any considerable quantity of grease, enough will be pressed out to judge of color, hardness and sweetness; if the nut tastes oily, and yet oil does not come out by this treatment, it is well to dry the kernel before squeezing; and, in the case of nuts containing grease solid at a high temperature like that of the *Myristica sebifera*, it is well also to heat the nut. Where a stearic candle can be got, and is burned down a little, until it has formed a cup, and then blown out, into this a little of the material to be tried may be placed; after a moment's burning, the candle material with which the wick is saturated is burnt out, the new material in the cup, takes its place, and becomes the material supplying the wick until the cup is emptied, and so can be judged of, or a piece of string dipped in the oil or melted grease makes a very tolerable wick; or simpler still, where the nut is very full of oil, if lighted at one end, it will at least show what tendency to smoke there is, and the color of the light.

"Some of the resins ought to come in for candle-making, though I believe that they have never been extensively used, except for the commonest sorts of candles, on account of their giving off so much smoke; but as some descriptions smoke less than others, there is a hope that new ones may be found smoking still less, these would then be very serviceable in candle-making. The points connected with new greases, &c., that we should be most thankful for information upon, are the manner of growth, probable expense of collecting, means of transport, and quantity likely to be obtained, with small specimens of the grease, if manufactured, and of the fruit, with both its husk and hard shell, where these exist."

The collection submitted to the notice of the Jury consisted not only of such oils and tallows of vegetable origin as are contained under Class III., but also for the sake of convenience, those included under the mineral and animal divisions,—classified according to their sources of production, but in themselves too few to demand the attention of a separate Jury. Accordingly the collection included—

1. Vegetable fixed oils.
2. Animal oils and fats.
3. Medicated and scented oils. That is oils having an ordinary gingelly or other oil for a base, but medicated and scented with herbs, roots and flowers, for medicinal or perfumery purposes.
4. Mineral oils.
5. Volatile and essential oils, and attars.
6. Wax and candles.
7. Soaps.

1. *Vegetable fixed oils.*—Consisting of species of "sarsoñ" oil, "rai" (mustard), linseed, safflower seed, "tárámíra," poppy seed, sesamum, and several other individual samples of less common oils.

"Sarhoñ" oil or "sarsoñ" oil, one of the most largely produced, is a dark yellow oil, valuable for burning purposes; and if clarified, is a very superior oil. It is, however, apt to become rancid and has an offensive smell. Much of this is due to the very inferior method of preparation commonly followed. As the excellence of an oil depends mainly on its purity, that is, its freedom from mucilaginous matter, sedimentary vegetable particles of the seed and other foreign substances, it follows that any method of manufac-

ture which allows of these impurities in the maximum proportion, must necessarily be eminently defective. The common method of extracting oil is by a rude machine, called a "kohlú;" this is in fact a gigantic wooden pestle and mortar.

A large hollow wooden mortar is fixed into the ground, and a stout wooden pestle is placed into it, leaning against the edge, the force with which it presses is further augmented by a heavy weight. In this position a long pole is attached to the upper part of the pestle, and either oxen are yoked to the pole, or men move it by walking round and round, forcing the pestle with them, its upper end moving round and round against the inner edge of the wooden mortar, and its grinding end working round at the bottom, and crushing the mass of bruised oil seeds placed there. At the bottom of the mortar is a hole leading to a smaller reservoir or chamber cut in the thickness of the wood underneath; into this chamber the oil drops, and is thence drawn off by a pipe which comes out at the bottom of the mortar near the ground, and falls into an earthen ghara or jar placed below the orifice. This is the method adopted in extracting all the common kinds of oil that are made in any quantity; the druggists who extract small quantities of lettuce seed or almond oil, &c., make use of a small screw-press. The bruised seed or nuts being placed in a circular box upon a firm pedestal or foundation, a pressing board sometimes (made of metal if the press is very small, which it usually is) is made exactly to fit into the box containing the seed, and is then pressed down upon the seed by means of a screw worked by a double armed handle, like a clothes press; the oil escapes by little holes in the box into a trough made all round the edges of the box, and the trough is emptied by a pipe or channel into a jar.

A prize was offered for a cheap oil press, but none appeared: it is a great desideratum. The ordinary press in use in Europe is on the principle of first bruising the seeds between iron rollers, and then expressing the oil in a screw press, by steam or hydraulic power. It would not be difficult to contrive an adaptation of the principle within the means of Punjab cultivators. Experiments might be tried, and the example set in jails, where oil extracting is often practised, and deserves to be very much so, as the labor (prisoners being employed) is really hard and distasteful, as the severer forms of prison labor ought to be.*

There was not much difference in the samples of oil exhibited; and all the seeds were precisely alike. Some samples were very thick with impurities. A sample from Hushyarpúr, and one from Gujrát and Shahpúr, were about the best. The oil is much improved by allowing it to stand till the impurities sink, and then decanting off the clear liquid, so that it is possible that some of the cleanest, and especially the small samples, were fallaciously clear and good looking.

Besides the "sarsoń" oil, there are several varieties of mustard seeds and crucifers, yielding an oil more or less resembling in color and properties the "sarsoń" oil.

The seeds may be enumerated as—"Tarah" or "tárámíra," "torya," white "sarsoń," black "sarsoń," white "rai," black "rai" (mustard) and turnip seed. The white varieties of seed generally impart less coloring matter of the epidermis to the oil, and are somewhat purer and higher priced oils.

* This subject ought to receive the attention of jail officers. Not only is the hard labor extremely useful, since it affords a medium punishment to send a man for so many hours to the oil-mill; but the oil might be made very remunerative on sale, if purified simply by agitating with hot water and salt, and then filtering it first through clean sand and then through charcoal. When once it is known that the jail in a station would supply cleaned lamp oil, there would be a regular demand for it, as cleaned oil is not to be had in the bazar. The Superintendent would buy up a good store of seed when the market was favorable, and thus, with care and management, a good profit be secured with very little outlay.

"Tárámira" is called "assú" in Panjábí, and the inferior kinds of oil yielded by it is called "karwá tel." "Tárámira" oil is esteemed among other uses as a medicine for cattle. It is made in Dera Ghází Khán in large quantities for export to Sindh.

"Torya" is a small seed, and its oil is similar to the others. Turnip seed oil is less common, as is also cress seed (*Lepidium sativum*).

Sesamum oil is prepared just in the same manner, either of washed seed or of unwashed. I have never seen the red-seeded variety of "tíl," spoken of by many authors. There is the common blackish brown variety, which yields the inferior sesamum oil, and if these seeds be first blanched by being boiled slightly in hot water, and then rubbed till the epidermis of the seed comes off, and then the oil be expressed, a much clearer and purer liquid is obtained. The latter process yields about 40 per cent. of a clear pale yellow oil, which is, when fresh, quite pleasant to the taste and inodorous. It is imported into France, where it is used to adulterate olive oil. Its inodorous properties render it valuable to mix with orange flowers, to produce the scented "karna" oil, or with rose or jessamine flowers, to make the Múltání tel, the "raughan-i-guláb," "motya," "rabél," &c. The medicated oils of "lubán" mastic, "asárún," and "ambaltás," &c., &c., are all prepared with white "tíl" oil.

The washed "tíl" oil is that which is usually burnt by Europeans in their lamps. "Sarsoń" oil never answers, both from its impure quality clogging the machinery of a European lamp, and from its bad smell.

Among the sesamum oils is to be noted a very good sample of cleaned lamp oil from the Sealkot Mission Industrial School. This is sesamum or gingelly oil, purified by agitation with sulphuric acid. The acid attracts, decomposes, and turns black the particles of mucilage and vegetable matter. The acid is separated and the oil repeatedly shaken up with water, the foreign matter subsides, and the clean oil is poured off—this is the most effective method. Sometimes oil is agitated with water in a leaden vessel, the lead acting on the mucilage, &c., and causes it to subside, but this is not a very effective plan. Where sulphuric acid is not procurable, washing the oil with salt and scalding water, and then filtering through sand and charcoal, will be found to answer admirably.

The Jury considering also the samples of pure turpentine, and the soap exhibited by the Industrial School, and to be noticed presently, award a Silver Medal and Certificate of Merit for the collection; at the same time commending to public sympathy and support this excellent institution, which aims at finding employment and support for Native Christians, whose change of religion has involved lost of caste and an exclusion from their natural communities, and thus from their ordinary means of livelihood. Such an institute benefits society, not only by converting a helpless population, which would be otherwise dependent, on scant and precarious charities, into a self-reliant and self-supporting community, but illustrates practically to all around, the advantages resulting from improved methods of manufacture of articles hitherto produced only in their rudest and least valuable forms.

Linseed oil.—This is a dark-yellow oil, and is, from the hardness of the seed much freer from mucilage and impurities than the rape seed oils: the native seed, which is smaller and redder in color, is much more productive in oil and much less in fibre than the European seeds. The oil is used to make printing ink, and is a "drying oil," besides being the basis of varnishes for carriages and furniture polish; the Gujrát and Shahpúr samples were very good, as also those from Dera Ghází Khán.

Safflower seed.—This is produced from the white seeds of the *Carthamus tinctorius*. As a dye, the plain districts produce a flower very inferior to the hills, but for oil purposes the locality seems indifferent. There is a wild variety, called "karar," which has a smaller

and mottled gray seed. This oil deserves to be much more extensively produced than it is. It is clear and of a pale golden color; it is esculent; and is said to burn with remarkably little heat: this property would render it invaluable for lamps.

Poppy seed oil.—Is expressed from the black and white poppy seeds; but there is no difference in the oil, which has somewhat a greenish cast; the samples are all good and clear. The seeds are so minute that the amount of impurity and mucilage is very small. The oil is bleached by exposure to the sun. It is invaluable to the painter, and when quite fresh is wholesome enough as an esculent oil.

These are all the oils that are produced in quantity in the Punjab; but the collection contained a large collection of other oils which are used occasionally.

Oils from the seeds of the Gourd tribe —Nearly all the species of gourds and melons, and cucumbers, *L. vulgaris, C. pepo, C. melo, C. utilissimus, C. sativus, Luffa pentangula*, &c., yield mild clear culinary oils; the skin of the seed is removed, and the inside, under the name of "maghz" khiyar, kadú, &c. &c., sold, and the oil expressed.

Cotton seed yields a pale golden oil, used medicinally.

Lettuce seed gives a clear transparent oil.

Almond oil is expressed by the druggists at the rate of 10 to 13 Rs. a seer (from almonds brought from Persia *viâ* Kabul). A small iron screw press is the implement generally used.

Among the Hill oils, there is a sample sent from Kangra (the only one) of the "bhaikal," or *Prinsepia utilis;* a sample of oil of a clear good appearance from the kernels of the "sári," or *apricot* stones (sent also from Simla). The apricot is cultivated extensively both for fruit and kernel in Kanáwar; and the kernels are sometimes sold in the bazars of the plains, under the name of "badám kuhi." The oil contains a trace of Prussic acid. It is of a deep gold color. The Kangra district sends also a sample of "mahwa" oil (*Bassia latifolia*), accompanied by a box of the glossy brown nuts which yield the oil—the sample is the only one sent.

Walnut oil, is a very valuable oil in hill districts, where the fruit is abundant. It is seldom seen in the plains: the same is true of the oils yielded by the seeds of the edible pine and of pistachio nuts. Among these series were two very fine samples of vegetable tallows—one is from *Stillingia sebifera*, a large cylindrical piece of pure hard white tallow—this comes from Dera Dhún. The *Stillingia* tree is growing in the Punjab, and has seeded, but I have not seen any sample of tallow produced. The other sample is in little snow-white cakes, being the ghí or butter from *Bassia butyracea* of Kamaon; it is esculent, and acts as a pleasant emollient for chapped hands. Both samples are exhibited by Dr. Jameson, and are accompanied by samples of the seeds or nuts of the plants. The Jury are precluded by rule from awarding a prize, as the samples are not the produce of the Punjab; but they desire to mention them with approbation, as most valuable and instructive specimens.

The *animal fat oils* were comparatively few in number, but were nevertheless curious.

A good sample of bear's grease comes from Kangra; as also of leopard's grease. Tiger's grease, prepared as a medicine, was sent by the Gugaira Committee; who also sent very good samples of suet and sheeps' tallow, clarified and prepared for use.

The Dera Ghází Khán collection had two uncommon oils—one prepared by soaking scorpions in common oil, and the other obtained from the fat of the pelican, and called "raughan-i-pín."

The Lahore collection contained an oil extracted from the unctuous bodies of the red velvet insect, "bír búti," used as a vesicating and inflammatory agent; and also an oil called

"raughan baiz-i-murgh," and said to be obtained from hens' eggs, no doubt the egg does contain an oleaginous matter, and egg-shells submitted to dry distillation yield an offensive oil.

It is needless to remark that these peculiar substances are found only in native Materia Medica.

The most interesting, commercially speaking, in this department, were a series of specimens of wax; but they were, without any exception, dirty masses of brownish or dirty-colored wax, which would all need refinement. One beautiful sample of white wax, clarified and melted into a disc shape, was exhibited by MR. C. A. D. GORDON, the wax being produced in the Gurdaspúr hills. A sample of candles, made from similar wax, was also exhibited by MR. B. POWELL. A very offensive smelling oil is extracted from wax, which, when allowed to evaporate on the finger, leaves a waxy substance in residue. It is used in native medicine under the name of "raughan-i-mom." Samples were sent from Amritsar, from Dera Ghází Khán and from Lahore.

The number of medicated oils was very great; besides a number of rarer substances that yield an oil by expression. There are a large number which consist of a pure sesamum oil, in which is either boiled (as in the case of "mustagi," "lubán," and resinous oils), or else merely steeped, the herb, &c., required. These articles are of no commercial value, and a description of their properties belongs more properly to a consideration of medicines. Among this list there is an oil obtained from the berries of the "bukhain" and "nim," which, is quite uncommon here, but forms an important article of commerce in Southern India, under the name of "*margosa oil.*"

There is one, however, among the medicinal oils that deserves particular mention as being useful for burning, and other purposes also.

This is the "arind-ká-tel," or castor oil, from the fruits of *Ricinus communis*. There are two varieties—one with large seeds, and one with small. A good sample of the former came from Delhi, and of the latter from Kangra. MAJOR DRURY says, "that the large seeds yield the burning oil, and the small the purgative oil." The samples of castor oil are very bad. They are quite semi-opaque, and unlike the clear limped sample of cold drawn European castor oil, that was exhibited for comparison. The opacity of the oil is due to the large amount of mucilage and vegetable matter which comes out along with the oil in the very defective mode of extraction employed, which is by the press, and not, I believe, by the "kolú." Castor oil is soluble in spirits, and accordingly a sample of the oil, taken from the Amritsar bottle, was shaken up with rather more than its own bulk of spirits. The oil was taken up and dissolved, but not so the mucilage and impurities. The mixture after being well shaken, was allowed to settle and the spirits to evaporate, the impure parts then separated and coagulated at the surface, as a flocculent whitish mass, leaving clear bright oil of about equal bulk below; hence is demonstrated that the bad quality of the oil is due solely to faulty preparation. It is the custom in some places to roast the seeds first and then bruise them in boiling water, by which means the oil comes to the surface and is skimmed off.

The following improved methods of manufacture are taken from AINSLIE and from the "Madras Jury Reports."

"Take five seers of the small castor oil nuts and soak them for one night in cold water; next morning strain the water off and put the nuts into more water and boil them in it for two hours, then strain off. The nuts are then to be dried in the sun for three days, after which to be well bruised in a mortar. Add to the nuts thus bruised 10 measures of water and put on to boil, stirring it all the time until all the oil appears at

the top, then carefully strain off, and being allowed to cool, it will be fit for use. The quantity of nuts mentioned in the above recipe should yield one bottle of oil. If cocoa nut water be used instead of common water, the oil has a paler and finer color."

Another way of preparing the oil is given in the Report of the Juries on the fixed vegetable oils sent to the Madras Exhibition. "The fresh seeds after having been sifted and cleaned from dust, stones, and all extraneous matters are slightly crushed between two rollers, freed by hand from husks and colored grains, and enclosed in clean gunny. They then receive a slight pressure in an oblong mould which gives a uniform shape and density to the packets of seed. The 'bricks,' as they are technically called, are then placed alternately with plates of sheet iron in the ordinary screw or hydraulic press. The oil thus procured is received in clean tin pans, and water in the proportion of a pint to a gallon of oil being added, the whole is boiled until the water has evaporated, the mucilage will be found to have subsided and encrusted at the bottom of the pan, whilst the albumen solidified by the heat, forms a white layer between the oil and the water. Great care must be taken in removing the pan from the fire, the instant the whole of the water has evaporated, which may be known by the bubbles having ceased, for if allowed to remain longer, the oil which has hitherto been of the temperature of boiling water, or 212°, *suddenly* rises to that of oil, or nearly 600°, thereby heightening the color and communicating an empyreumatic taste and odour. The oil is then filtered through blanket, flannel, or American drill, and put into cans for exportation. It is usually of a light straw color, sometimes approaching to a greenish tinge. The cleaned seeds yield from 47 to 50 per cent. of oil, worth in England, from 4*d.* to 6*d.* per lb."

"In France, the fresh seeds are bruised and then put into a cold press. The oil thus expressed is allowed to stand some time to permit the albumen, mucilage, &c., to subside, or it is filtered to separate them more rapidly. The produce is equal to $\frac{1}{3}$th of the seeds employed, and the oil possesses all its natural qualities. The oils made in France and Italy are much weaker than those procured from tropical countries. Another mode of obtaining the oil is to macerate the bruised seeds in cold alcohol by which 6 oz. of oil are procured from every pound of the seeds. Castor oil is soluble in pure sulphuric ether and alcohol. It also combines easily with alkaline leys, by which is formed a test of its purity. It is one of the best ways of overcoming the repulsive taste by mixing the oil with an alkaline ley, which alters the appearance of the oil, but does not destroy its purgative powers. Other ways of rendering the oil less unpleasant are by using lime juice, orange peel, coffee, gin, or an emulsion of the yolk of egg. Castor oil is a mild laxative medicine, and among the Hindús is used as a remedy in cutaneous affections externally applied. It is particularly recommended in rheumatism, lumbago, and habitual constipation, piles, and other diseases of the rectum. Alone or mixed with turpentine it is efficacious in expelling worms. Air should always be excluded to prevent rancidity, although when rancid, it may be purified by calcined magnesia."

The plant is very easy to cultivate, if sown in a moderately moist place, after the rains. It would form a valuable plant as a hedge to jail gardens, &c. The leaves are food for silk-worms.

The *scented oils* have been before alluded to. The principal kinds are "karná tel," "raughan-i-gulâb," "motya" "rabel," &c. They are prepared by taking pure white "tíl" oil (gingelly), and soaking in it rose petals, or jessamine, or orange flowers, &c., as the case may be. They are pleasant and not too powerful; but the perfume soon goes off. They would make very good hair oils.

The *attars and essential oils* are very well represented.

Attars are mostly the volatile oil of flowers. The petals are placed in a still with a little water, and the liquid gently and carefully distilled over: on the surface of the liquid which passes over is found floating in small quantities the essential fragrant oil which is carefully skimmed off and preserved. The essential oil distilled from cloves, &c., is heavier than water and sinks instead of floating, There are one or two other attars prepared from musk, ambergris, &c.; and one of these, (the composition is not known,) is distilled, or said to be so, from earth or clay: this is the "atr *gil*," not to be confused with (atr *gul*): it has a peculiar and pleasant smell, less powerful than most of the others.

The attars are some of them prepared at Amritsar; but some, such as the attar of the

flowers of the *Pandanus odoratissimus*, are brought from Hindústán *viâ* Delhi, and from Benares.

These perfumes are so powerful, that the smallest drop is almost over-powering, and produces a sensation of nausea with eventual headache.

The lemon grass oil is perhaps one of the most pleasing of this nature, and is extensively prepared in Ceylon. One or two samples of lemon grass were sent to the Exhibition, but no oil. The grass is very common in parts of Bengal.

A fragrant attar is however obtained from the "khas" (*Andropogon muricatum*), a congener.

There were several seeds exhibited, but no oil with them. The seeds of *Moringa pterygospermum*, were thus sent from Hushyarpúr, and the black kernel of the "harítа," or soap nut, from Lahore; as also a seed or brown nut, called "namúlí."

Wood oils, as before observed, are only represented by a dark-colored empyreumatic oil from the *Pinus longifolia*; and another from the *Cedrus deodara*, which is sent both from Kangra and Simla; and a fine sample of oil from the *seeds* of the deodar (not the wood) is exhibited by Dr. Jameson.

This concludes the oil series.

The Jury award as follows:—

The Special Prize of Rs. 25, offered by the Punjab Railway, for the best collection of native oils, is awarded to Ram Singh of Lahore, who exhibited a complete series of nearly 150 samples, embracing all the fixed vegetable oils, medicinal oils, scented oils and attars, and animal oils, in one. The Jury have augmented the Prize by Rs. 10, making a total of Rs. 35.

The Second Prize of Rs. 25, is awarded to the Local Committee of Kangra, for the excellence of the oils, and the interest attaching to individual samples, such as *Prinsepia* oil, "mohwa" oil, and bears' grease.

To the Local Committee of Shahpur, a Prize of Rs. 15, for general excellence of the oils.

A Certificate of Merit is given to the Gujrat collection, for pure and good oils.

The Jury make Honorable Mention of the collection from Dera Ghazi Khan.

To Mr. C. A. D. Gordon, a Certificate and Prize of Rs. 10 is awarded, for white wax, produced in the Gurdaspúr Hills.

Soaps.—The collection includes several samples of native soap, all made on the same principle, with oil, "sajji" and lime; the best of them is a sample from Gujranwalla, got up with some care, and some of the cakes colored pink with "kussumbha." This soap is a harsh material, useful enough for scrubbing and cleansing purposes, but not pleasant to wash with, and its smell is somewhat unpleasant.

But the most excellent sample of soap, quite surpassing any other, is that produced under the name of "saddle soap" and "family soap," by the Sealkot Industrial School, before alluded to. The soap is of the nature of a yellow soap, and semi-transparent wax-like, yields easily to water, and lathers well. In addition to a Medal and Certificate awarded to this school, the Jury awarded a Prize of Rs. 30 for soap: this sample only shows how all the materials are at hand for producing a first-rate article of such wide and necessary consumption.

Second only to this sample, is the soap made and exhibited by MR. W. SPENCE, of Sealkot, and who is believed to have been the first to start the improved process at Sealkot. He has a useful scrubbing soap in bars, and some neatly stamped round cakes of a scented brown soap.

To this sample the Jury awarded a Certificate of Merit.

On reviewing briefly the whole collection, there can be no doubt that the materials for first-rate oil production are at hand, but some improved method of extracting the oil must be found and adopted before any permanent improvement can take place. The Jury commend this subject to the notice of officers in charge of jails.

The subject of cleaning oils, too, is an important one, and deserves attention.

The production of wax is another very important subject. If pains were only taken it might be produced in great quantity, and as the bleaching requires little else than light and air, no difficulty need be experienced. The whole process of purifying wax in Europe consists in forming the wax into thin ribbands or shreds, so as to expose it on trays to light, dew, and air, &c., for some time. There is no reason why this province, with wax like the sample shown by MR. GORDON, should not be quite independent of Europe for candles.

As to animal fats, there seems to be no lack of supply, but some classes of natives have caste prejudices against this manufacture—though fats appear to yield better soap than the mustard oils commonly used. In Europe, bones are boiled down to yield fat, which they do in large quantities; the waste of animal matters which is perpetrated in India must be enormous—the subject is worth attention. In Paris, the very dead dogs from the Seine are boiled down for tallow; and the skins of the rats in the sewers, are converted into kid gloves!

These are perhaps extreme instances, but the maxim—waste not, want not—is as true in India as in Europe, and as the tendency of trade extension and civilization is to utilize everything, from the most beautiful products of nature down to the vilest refuse.

B. POWELL,

Reporter to the Jury.

CLASS IV. SUB-CLASS (C). SUBSTANCES USED FOR DYEING, INCLUDING CLOTHS DYED TO ILLUSTRATE THE PROCESS; PRINTED OR STAMPED FABRICS, AND BLOCKS USED IN MAKING THEM; INCLUDING ALSO, ARTISTS' AND OTHER TRADES' COLORS.

In order to see the whole of the substances made subservient in this Province to the art of coloring, whether of dyeing or printing cloths, or painting, or enamelling, the reader should look back to the pages under Class I., already devoted to a consideration of such of these substances as are yielded by the Mineral Kingdom.

The present Sub-class, however, includes the majority of these substances which are products of the Vegetable Kingdom. In presenting to the reader a brief account of the principle colors which the dyer is capable of imparting, I shall notice all dyeing materials used, without reference to their origin.

The apparatus of a native dyer is very limited and inexpensive. His fire and pans, wherein he can boil such articles as require it, earthen "nánds"* and jars of various sizes, and cloth for filtering, constitute almost his only requisites. The workshops of native dyers are generally dirty in the extreme—notwithstanding this, colors of surprising beauty are often produced.

Some of these colors are very permanent; but others, perhaps the majority, are not so; and the art of brightening and fixing by mordants is very imperfectly practised. The principal varieties of fabrics submitted to dyeing are—*silk*, *cotton* and *wool*—and the processes as well as the materials, differ somewhat in each.

The following is a list of colors which can be produced, both simple and compound; and of the substances used in the production of each.

Red, with yellow spots, &c.—Dyed first yellow, then wherever the spots are, the cloth is gathered up into a little bunch and tied tight all round with thread. In this state the cloth is dipped in kussumba, and when it comes out the whole cloth is red, except where the little knots were formed, which, when the cloth dries, the knots are opened out, and there are little yellow spots in the place of each.

Red, with white spots.—Prepared on the same principle, only the white cloth is first tied up and then red dye applied. It is not necessary to enumerate all the varieties of colors that are prepared in this way, as the principle is the same in all cases.

Surkh — crimson. — Kussumba, brightened with kishta.

Gulanár—scarlet—Kussumba and turmeric (haldí).

Kirmzí—crimson.—Kussumba; and then with a very faint shade of indigo, dissolved as for indigo dyeing.

Náfarmání—lilac—mauve.—Kussumba, and then "níl kachá," the common indigo merely pounded up fine in water, not dissolved regularly as for indigo dyeing.

Sosni—lilac.—Kussumba and "níl pukhta," or dissolved indigo.

Nárangí—orange color—Tún flowers and kussumba.

Kesarí—sort of saffron color.—Ditto, in fixed proportions.

Sunehri—gold tint.—Ditto.

Kásní—very pale lilac.—Kussumbá and "kachá níl" (indigo).

Gul ámbarí—A sort of bright lilac, in which the crimson and the blue are not thoroughly combined, so that there is the effect of a "shot."—Kussumba and Prussian blue (Wilayití níl).

Piyází—very pale pink or flesh colored.—Kussumba and khatai (lime juice).

Gulábí—pink.—Ditto.

Sandal-i-surkh—reddish brown.—Kath gulábi (catechu) and kalaí (whiteing).

* Called in Panjábí "matt."

Sandal-i-safed—drab yellowish cast.—Kath (catechu only).

Shutri—camel color.—Catechu in proper proportion.

Halwaí—color of sweatmeat—pale drab.—First with naspál, pomegranate rind, then with catechu.

Agraí—drab.—In the same way, with different proportions.

Túshi—dark brown gray.—Naspál and catechu.

Múshi—rat color.—The same in proper proportions.

Lájwardi—ultramarine.—Lajward—artificial lapis lazuli.

Shingarfí—Cinnabar—Cinnabar ground fine (not permanent).

Mallageri—shade of brown.—Catechu only.

Sardaí—color of ripe melons.—Tún flowers (yellow), and a faint shade of kussumba.

Angúrí—pale green (grape color).—Asbarg, turmeric and "níl kachá."

Sábz.—green—Naspál, turmeric and indigo dissolved.

Zamrúdi—deep green.—Naspál, indigo, turmeric and alum.

Zamrúdí mail siyaí—very deep green—"invisible green."—The same, with more indigo.

Siyah bhor—the color of the black bumble bee (bhor).—Dissolved indigo, naspál, turmeric and alum.

Naswárí—snuff color.—Catechu only.

Fákhtaí—gray—Kíkar pods and catechu.

Champa-i-zard—(champa flower color).—Tún, and a little kussumba afterwards.

Káfúrí seotí—yellow pale.—Tún flowers.

Kapási—color of flowers of cotton plants.—Turmeric, then asbarg and alum.

'Atishi gulábi—bright rose color.—Kussumba and khatai.

Basanti—yellow bright pale lemon.—First turmeric, of the sort called agrai, the best, which easily breaks* up, and asbarg and alum.

Basant-i-mail surkhi—yellow with crimson tint.—Turmeric, and then a little kussumba, and then a solution of alum.

Firozí—Turkis blue.—English sulphate of copper and whiteing (not fast).

Shákh chinárí—(lit., plane tree branch)—it is yellow with a suspicion of black or blue.—Asbarg, and then indigo kachá.

Tabáshírí—pale yellow with tone of blue.—Asbarg, and a little indigo kachá.

Kulfi—deep lilac, blue prevailing.—Kussumba and dissolved indigo.

Dárchíni—cinnamon colored.—Catechu.

Zíraí—shade of brown drab (color of zíra or cummin seed).—Naspál and catechu.

Khákhí dúdhyá—gray.—Kíkar pods and catechu.

Yashmí—color of jade stone.—A little turmeric first, then asbarg and alum.

Khákhí mail siyahi—darker gray.—Catechu and kíkár pods.

Gerái—dark red.—Geri—earth.

Surmáí—deep blue-black.—Indigo.

'Abí—pale blue.—Indigo.

'Abí nukrai—silver gray.—Pale indigo.

'Asmání—sky colored.—Indigo.

Kakrezi—liver colored.—Bakm (sappan) and catechu, and naspál.

'Unábi—(color of bér fruit—reddish).—Bakm and naspál.

Nabátí—pale brown like sugar.—A little kussumba and then tún.

Gul-gaz—crimson brown, maroon.—Kussumba and a little catechu.

Gul-abbási—color of Marvel of Peru—magenta.—Kussumba and a shade of blue.

Zangári-pukhta—verditer, permanent blue.—Copper filings in solution of sal-ammonic and borax.

The process is peculiar, the cloth is first carefully steeped in the white of eggs beaten up into a froth. When this has been thoroughly accomplished, the cloth is spread out, and very fine copper filings are sprinkled all over it, and the cloth is then tightly rolled up enclosing the filings: the roll is next moistened with a solution of borax and salammoniac, and is kept kneeded and rolled about for some time, while the operator constantly sprinkles it with the solution: the color produced is permanent.

Zangár kachá—verditer (not permanent).—Is made by dipping cloth into a solution of zangár, the subacetate of copper.

Vakmí—lilac pink.—Vakm, naspál and alum.

Vakmí kulfi—purple.—First with indigo, with alum solution; and lastly, vakm.

Pista—green (pistachio).—Naspál, turmeric, raw indigo, and alum.

Majít—madder red.—The cloth is first steeped in galls of tamarisk (máin), and then washed in oil, and then rinsed, after which it is dried, and then dipped in a madder vat.

1662.—[ ]. Indigo, níl (*Indigofera tinctoria*).

The native term "níl" is generally written with the term "kabúda" added to it, so as to prevent any one mistaking the word for "tel," oil, which is the same form in the Persian character, with a difference only of the dracritical points.

The various sources of indigo are fully discussed

* *See* "turmeric" in the sequel.

in the Jury Report; here it may suffice to observe that the indigos exhibited are all from the same botanical source, and are all that kind of indigo, which is called "gaud," that is merely in sun-dried pieces, without boiling or preparing in cakes.

The indigo from Múltán, and from the factory of MESSRS. SKINNER AND JARDINE at Hansi, and an imported specimen from Khúrjá, are the only exceptions; these are prepared in square cakes, previously purified by boiling the fecula. Indigo is by no means generally cultivated, although many districts appear to produce small quantities for their own consumption.

Dera Ghází Khán and Múltán are the great places for manufacture. In the former the trade has fallen off, on account, it is said, of adulteration practised on the goods; but formerly very large quantities were made and exported into Kábul and Khurásán, &c., by the Lohání Afgháns. As it is, about 2,000 maunds are yearly made in the district, at prices varying from Rs. 25 to 60 per maund.*

The prospects of indigo in the Punjab are thus alluded to in the Revenue Report for 1861:—

"As regards indigo, likewise, which ought to be one of the staple products of the Punjab, there is no improved progress to be noted this year, 1861-62. But as I was under the belief, as stated in my report, that owing to its defective manufacture, the article as here produced is not fitted for the Europe markets; I have read with satisfaction the subjoined extract† from a newspaper published in Kárachí, under the designation of 'Our Paper,' which affords a hope that it may yet be turned to account."

Attempts have been made to revive the manufacture at Sealkot, and though the produce is "gaud" indigo, it is very superior to what is produced in many districts.

MR. MACNABB, Deputy Commissioner of Sealkot, in 1862, wrote: "Last spring I got up one maund of seed from Allygurh, and made it over to HAKIM SING of Daska, and to a chaudri at Zaffrwál. The fourth of the cultivation of the former, and a good deal of the latter, were destroyed by floods, but we have 10 maunds of seed, which is enough for half the district.

"The specimens were good in color, but dirty and badly made, as was to be expected, as they were prepared in rough mud vats by unskilled men. All that is now wanted is to build pattern vats, and get up a well qualified man for a year from Allygurh to give instruction in the process."

The dyers acknowledge four kinds of indigo—1st, the best and dearest, "Wilayití níl," or indigo prepared in Bengal or the N. W. Provinces after the improved European fashion; 2nd, "Khúrjá níl," is indigo brought from Khúrjá, a town situate between Allygurh and Delhi; the 3rd, is "Multání níl," from district of Múltán, to be described presently; and the the 4th, the most inferior, is the "desi," or common provincial made indigo, either from this district itself, or brought thither from some other district of the Punjab.

The first two kinds need no remark, as they are imported, and the methods of growth and manufacture followed in the regular indigo districts cannot here be discussed; some notice of the subject, however, offering suggestions for the improvement of the local manufacture, will be found in the Report of the Jury annexed to this class.

The principal and most hopeful source of indigo is at present the Múltán district. "The Punjab Indigo Company" have recently established themselves there, and with every promise of success. For the growth of indigo in Múltán, a light rich soil is preferred, which has neither too much sand nor too much clay; the presence of "kalr" is fatal to the indigo crop. The high lands, called *ootar* or *ráwá*, are the best suited; constant irrigation is required, and that from canals, called *phuggoo*, is preferred; not much indigo is produced in lands watered by wells, because the irrigation is not sufficiently constant; for a similar reason indigo does not grow in "sailába lands" (irrigated only by temporary or periodical floodings). The sowing time is in the months of Baisakh and Jeth: the field is first ploughed four or five times, and then flooded with water; after which the seed is sown broadcast; the land is prepared for sowing during the cold weather after the winter rains. If sown in Baisakh or Jeth, 6 seers of seed suffice to sow one begah; but if later, 8 seers are required: but this one sowing lasts for 2 years—for the first year's crop being cut the plant grows up again—the second year's growth is called *moandeán*. The best lands

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* Punjab Selected Correspondence, Vol. IV, Part 4, p. 63.

† Extract from "Our Paper," of 20th June, 1862.

"Indigo, which from the crude manner of its preparation in Sindh has been hitherto unfit for the English market, has, in the past year advanced from rupees 3,60,859 in 1860-61, to rupees 11,03,544 in 1861-62. It appears to have been but lately discovered in England that Múltán indigo, notwithstanding its impurities, is of good color, and therefore possesses the quality which constitutes the chief value of this article. Some has been imported from Khyrpoor this year, which is superior to that of Múltán; and is consequently valued at rupees 10 a maund more. As the plant is indigenous both in Sindh and the Punjab, its produce might be exported to an indefinite extent. Heretofore it was exported only to the Persian Gulf, Afghánistán and Bombay; but in the past year, for the first time since 1847, several cwt. have been exported direct to England; and much of that forwarded to Bombay is also, it is believed, destined for that market."

will even produce a third year. If sown in Baisakh one beegah of land yields 10 seers of indigo the first year, and 8 seers the second; the expenditure of the cultivation for the first year is about Rs. 6-2-0 per beegah. The land is irrigated twice before sowing, and after that every third day for a month, at which time the plants are a foot high. After this, irrigation on the eighth or tenth day suffices, but a nice discrimination is requisite as to the quantity of water, too much being almost as bad as too little, causing the leaves to turn yellow and deteriorate.

Manure is not usually given, but weeding is carefully practised.

The production of indigo in Múltán began with the construction of irrigation canals, which were zealously promoted both by the Pathan rulers, and subsequently by the celebrated DIWAN SAWAN MAL. In those days the Government took no money assessment on indigo lands, but the zemindars paid "bhaoli" rates, or proportions of the gross produce, varying according as Government or the zemindars had constructed the canal inundating the land. If the Government had borne the expense, the rate was from ⅛th to ¼rd; if the zemindars, then the proportion assessed was from ⅛th to ⅓th. SAWAN MAL was a great promoter of these canals,* to such an extent that he realized from the Sirdanah of the Ladrán tehsil, 900 to 1000 maunds of indigo, where the Pathans only got 200.

Indigo grows to a height of 4 to 5½ feet. It is ripe and ready for the sickle when it begins to blossom. It is always cut before the seed-pods begin to form, and is cut about 6 inches or a foot from the ground. "Another test of preparedness," says MR. MORRIS, "is to take a leaf in the hand and rub it, if it leaves a black stain it is ready, not otherwise."

The vats, called "haunis," used for the manufacture, are built in sets of three—a large one on each side and a small one in the middle—the large ones are about 4½ feet in diameter, and 3½ feet deep, the small ones, half that size. It costs about Rs. 30 to build a set. When the plant is ready for cutting two men are required on 5 Rs. a month each, one to cut, and the other to tend the vats. The indigo being cut, is tied up in bundles. Eight or ten of these are placed upright, with the stalks downwards in the larger vats. At evening water is let on to cover the whole, but the bundles must not be left too long without water, otherwise the plant dries and is spoilt. The soaking continues for 24 to 36 hours, after which the bundles are removed from the vats, and the liquid is churned or agitated for some time by men with long paddles. The exact duration of this process, which is called "balowa," is a matter of great nicety, learnt only by experience. When this is done, the indigo sediment subsides, and the water above is drawn off; the sediment or fecula is then collected in the smaller vat, is strained through cloths, and dried in the sun, in little balls or cakes.

It appears that indigo cultivation fell off somewhat at the commencement of British rule, consequent on the Government having no motive for promoting any one particular crop, and partly because the canals were not so much attended to. But now that the company is at work, irrigation becomes a subject of great importance, and it is suggested that many of the simple Chinese expedients would be invaluable, especially for those estates which lie above the level of the inundation canals, and require to be watered by "jhalárs," Persian wheels erected over the edge.

There are three kinds of indigo produced—the first, and best, is distinguished by having a reddish lustre when polished with the nail—this is called *pammuáh*, and sells for Rs. 50 to 80 per maund. It is produced chiefly in tehsils Shujabad, Ladrán and Múltán.

The second is called "pakka sáwah," and values for Rs. 40 to 60 per maund.

The third is called "kacha sáwah," and sells at Rs. 25 to 40 per maund.

MR. MORRIS writes:—"From the above description of the manufacture it will be seen how rude the mode is, and how ill-calculated for the production of so rich and valuable a dye; still, notwithstanding this, it is greatly sought after by foreign merchants, and large quantities is exported to Bombay, Kábul, and other places. I have heard that notwithstanding the rudeness of the manufacture, the actual color is so good as to astonish the Bengal planters who have seen it."

MR. MACIVOR in 1855, wrote: "That he had tried experiments, and had made a sample of this indigo. He sent his sample, with some of the ordinary native production, to Bengal. His sample was valued at Rs. 140 per maund, while the other was pronounced not worth the cost of transport!"

Such a result should be highly encouraging to the indigo company, since it conclusively shows how intrinsically excellent the dye is, while at the same time, how enormously its success in the market is dependent on the "get up" and manufacture, which are just the points that the company will have widest scope for improving.

To show what other districts do in the way of cultivating indigo, the following particulars were communicated to the Punjab A. H. Society.

* *See* Chapter on Agriculture; also MR. MORRIS' account, "Calcutta Gazette," Dec. 19th, 1860.

From the Deputy Commissioner, Dera Ismaíl Khán, dated 10th February, 1863, stating, "that the indigo cultivation of the district did not exceed 50 acres; the price averaging about Rs. 70 per maund."

From the Deputy Commissioner, Ludhiana, dated 11th February, 1863, stating, "that there are probably not more than 1,000 acres of land under indigo cultivation in the district, the average yield of dye being about 17 seers per acre, and the selling price ranging from Rs. 30 to 45 per maund."

From the Deputy Commissioner, Jálandhar, dated 9th February, stating, "that the whole area under indigo cultivation amounts only to 495 acres, the average produce of the dye being 16 seers per acre, and selling price from Rs. 25 to 40 per maund."

From the Deputy Commissioner, Shahpúr, dated ——, stating, "that the cultivation of indigo is limited to a merla or so, here and there, grown for private consumption as a hair dye."

From the Deputy Commissioner of Ambálah, dated 23rd February, stating, "that 428 acres are under indigo cultivation in the district, that the average yield per acre is 16 seers, and that the price is Rs. 60 per maund."

From the Deputy Commissioner, Dera Ghází Khán, dated 13th February, 1863:—

"In this district, at a rough calculation, about 15,000 acres are cultivated with indigo, the average out-turn gives about 12 seers of manufactured indigo to the acre, so that about 4,500 maunds are manufactured yearly in the district; the average price is 40 Rs. a maund, giving Rs. 1,80,000 as the value of the indigo grown and manufactured in this district. About three years ago there was a great demand for indigo, and the cultivation of this plant was largely increased; since then the demand has lessened and the cultivation of the plants proportionately decreased. The plants of the first season are called 'rop,' and are the best; the second year, it is called 'moonds,' and is not so good; and the third year 'jis moonds.' It is kept only for seed. I will send two specimens of the manufactured indigo, the best kind and the average kind, with present value, in the course of the next few days. Any further information you may require shall be happy to supply."

There were 14 samples of indigo, in the Exhibition of 1864.

1663.—[4558]. Sample of indigo from MESSRS. SKINNER'S factory, by the Lahore Museum.

1664.—[ ]. Indigo. PUNJAB INDIGO COMPANY, Múltán.

1665.—[ ]. Gaud indigo, from Múltán.

Samples were exhibited from—
(4546-47) Sealkot.
(4438) Delhi.
(4446) Gurgaon.
(4452) Hissar.
(4464) Ambálah.
(4467) Ludhiana.
(4477) Jálandhar.
(4532) Amritsar (Multání níl).
(4636) Muzaffargarh.
(4643) Dera Ismaíl Khán.
(4645-66) Dera Ghází Khán.
(4663) Kapúrthalla.
(4680) Jhínd.
(4683) Pattiala.

1666.—[ ]. "Vasma," or "kalf." Powdered indigo leaves.

The dried and powdered leaves of indigo plant are used especially in hair dyeing. This operation is prepared by first dying the hair red with "mehdi" (*Lawsonia*) leaves, and then indigo powder is applied which makes it black; I believe also the curds of milk are employed in the process.

Samples of "vasma" were sent from—
(4592) Gujrát.
(4621) Gugaira.
(4647) Dera Ghází Khán.

1667.—[ ]. Madder. *Vern.*—Manjít, majíth, rodang (*Rubia munjista* or *R. cordifolia*). Called in Thibetan, "bTsod," and in Bunan dialect, "runa."

Madder is one of the most remarkable dyes, not only on account of its having like indigo no affinity for any mordant; but also from the peculiar chemical principles it exhibits on analysis.

The madder used by the dyers in the Punjab is principally that which is imported by the Lohání Afghans, from the hills of Northern Biluchistán, Kábul and Khurásán, and brought in large quantities to Múltán by the Shikárpúr and South Afghan Povindahs, and through the Khaíbar and northern passes by the Peshawar Kábul merchants. But madder abounds in the hills of the Himálaya, and in Naipál, while it grows also in the Nilgíri hills of Southern India. DR. CLEGHORN, speaks of it as growing in profusion in the valley of the Chandrabhága (Chenáb), and says that it is indigenous to the vallies of the Himálaya. A sample of madder is among the collection from Lahaul. Some French seed has been planted in the Punjab plains, and is growing now at Amritsar; but

as the plant takes three years to come to maturity, the root has not yet been tested.

Madder is chemically speaking one of the most remarkable of dyeing substances, and the comprehension of its constituents will do not a little towards suggesting improvements in, and extension of, the series of tints capable of being produced by the root.

The European madder is *Rubia tinctorum*, but another species, *R. peregrini*, is brought under the name of "Turkey roots" from the Levant, and much used in the process of dyeing Turkey red.

It is quite recently that a difference has been discovered between European madder and "manjit." The latter being found to contain a curious principle, termed munjestine. A brief account of the constituents of madder is here added, partly on account of the value to the dyer, attaching to a knowledge of the properties of madder, and partly to illustrate the difference of the madders of Europe and India.

When madder is extracted with boiling water, a dark brown muddy liquid, having a taste between bitter and sweet, is obtained. On adding a small quantity of an acid to this liquid, a dark brown precipitate is produced, while the supernatant liquid becomes clear and now appears of a bright yellow color. The precipitate consists of alizarine, purpurine, rubiacine, the two resinous coloring matters, pectic acid, oxidised extractive matter, and a peculiar nitrogenous substance. The liquid filtered from this precipitate contains the bitter principle and the extractive matter of madder, as well as sugar and salts of potash, lime and magnesia. No starch, gum or tannin can be detected in the watery extract. After the madder has been completely exhausted with boiling water, it appears of a dull red color. It still contains a quantity of coloring matter, which cannot, however, be extracted with hot water, or even alkalies, since it exists in a state of combination with lime and other bases, forming compounds which are insoluble in those menstrua. If, however, the residue be treated with boiling dilute muriatic acid, the latter dissolves a quantity of lime, magnesia, alumina, and peroxide of iron, as well as some phosphate and oxalate of lime, which may be discovered in the filtered liquid; and if the remainder, after being well washed, be treated with caustic alkali, a dark red liquid is obtained, which gives with acids a dark reddish-brown precipitate, consisting of alizarine, purpurine, rubiacine, resin, and pectic acid. That portion of the madder left after treatment with hot water, acids, and alkalies, consists almost entirely of woody fibre.

The most important principles in madder (excluding pectin, nitrogenous matter, resinous coloring matter), are alizarine, purpurine, and rubiacine.

Alizarine (C_{14} H_3 O_4) is a principle obtained* in yellowish red, lustrous acicular crystals.

At about 42° Fahr. these crystals sublime on hot charcoal, and when the sublimate is collected, the residue is pure anhydrous alizarine. Alizarine is insoluble in cold water, sparingly so in hot, quite so in alcohol, yielding a deep yellow solution. It is destroyed and made colorless by chlorine; and by nitric acid is converted into a colorless crystallized acid, called *phthalic acid*.

In caustic alkalies, alizarine forms a solution of a firm purple or violet color—if ammonia be the alkali employed, it will evaporate and deposit the alizarine as crystals. These alkaline solutions yield with lime and the salts of baryta, beautiful purple precipitates, varying from purple to black; as also with iron salts. Indeed, most of the salts of metallic oxides yield various shades of purple precipitates. The salts of alumina gave a red precipitate. Hence cloths prepared with solutions of mordants of the salts just named, can be dyed with pure alizarine, and the depths of the tones produced may vary from pink and lilac to red and black, according to the strength of the mordant used: nevertheless, it is found that the other constituents of madder aid in forming the purples and red, and that (these) colors when produced with madder, and not merely with the extracted alizarine by itself, are more powerful than when dyed with alizarine extract alone; while the delicate shades of pink and lilac was found to be almost wholly dependent on the alizarine alone. This fact is very important to the dyer.

Purpurine, the second mentioned constituent of madder, is very similar in appearance to alizarine. It crystallizes in small orange-colored or red needles. It can be sublimed, is sparingly soluble in boiling water, giving a pink solution, and in alcohol with a deep yellow. It yields, like alizarine, *phthalic acid* on treatment with nitric acid, but *unlike alizarine, it is soluble in alum liquor*.

"When treated with a boiling solution of alum in water it dissolves entirely, yielding a peculiar opalescent solution, which appears bright pink, being transmitted and yellowish by reflected light."—(URE).

When the alum solution is cold, if sulphuric or hydrochloric acid be added in excess, a precipitate of yellow flakes of purpurine falls. *On this property depends the method of separating it from alizarine.*

The compounds of purpurine with bases are purple.

* Alizarine was obtained by ROBIQUET by making a cold solution of madder, which he allowed to gelatinize, treated the jelly with alcohol, evaporated the alcoholic liquid to dryness, heated the dry residue and the alizarine sublimed, and was collected as a dry crystalline sublimate.—(URE).

It dissolves with caustic alkalies, with a bright purplish red color, the solutions *unlike alizarine*, lose color and change by exposure to air. The *reds* and *blacks* yielded by purpurine are superior to those yielded by alizarine, being more intense. This explains the statement above, that the reds and blacks dyed by madder (containing both, is alizarine and also purpurine) were better than those dyed only by alizarine; but on the other hand, the purples and violets of alizarine are better than those of purpurine, which also explains what was said before.

Purpurine colors are, however, less fast than alizarine, and will not bear so well any subsequent action of soap, &c. A derivative from purpurine, called purpureine, has recently been obtained by allowing a solution of ammonia, water and purpurine, to stand for some time, occasionally supplying the loss of ammonia and water by evaporation, by adding fresh liquid. A subtance separates of its own accord, which dyes unmordanted silk and wool, rose color.

Rubiacine.—Crystallizes in greenish yellow lustrous scales or needles. It volatilizes over heat and yields a yellow crystalline sublimate. It is soluble in boiling alcohol, but is deposited when the solution cools. *It is not decomposed by boiling nitric acid.*

Caustic alkalies generate it a purple solution; earth and metallic oxides, red. Treated with a boiling solution of pernitrate or perchlorate of iron it dissolves entirely in a brownish red solution, which, when cold precipitates by excess of hydrochloric acid a flocculent yellow sediment, which is rubiacic acid.

In madder there are also two amorphous *resinous coloring matters*, which have been called *Verantine* and *Ruboretine*, which exert a prejudicial rather than a beneficial effect, during the processes of madder dying. In fact, their action has to be counteracted.

Pectin appears to be a constituent quite indifferent to the dyer, unless as far as its facility for passing into *pectic acid* is concerned, when it might exert a bad influence, by destroying the attractive powers of the mordants.

The extractive matter, which when pure, looks like a yellow syrup, has scarcely any effect, since its solution is not precipitated by bases or earths, except that at a high temperature especially, it combines with the oxygen of the air, and forms a brownish solution, which then *can* be precipitated by sugar of lead. The solution of extractive matter in water, if treated with sulphuric or hydrochloric acid, becomes green; hence the matter is sometimes called Chlorogenine or Rubichloric acid.

This extractive matter mixed with the *bitter principle*, has been called *Xanthin.*

This bitter principle has been the subject of much discussion and experiment: it has been supposed to be the origin of all the other coloring matters, by undergoing certain processes by natural causes, as yet unexplained. An admirable account will be found in DR. URE'S Dictionary, Vol. III., p. 9. The enquiry was excited by observing that the root as it grows contains none of the above well-defined principles, but a certain yellowish extract; and also by the fact that madder improves by keeping up to a certain time, and by exposure to the air.

In dyeing with madder, it is necessary that the water used should be calcareous, or made so by adding a little lime. The lime combines and mixes with those constituents of madder that are injurious, and allows the alizarine to act freely.

The new principle that is contained in the madder of Khurásan and the Himálayan valley, is as already stated, *Munjestine;* and this substance has been made the subject of minute investigations by DR. STENHOUSE, which are recorded in the "Proceedings of the Royal Society of Great Britain," Vol. XII., p. 633, and Vol. XIII., p. 145.

Munjestine was obtained by boiling "manjit" in a solution of sulphate ammonia, repeatedly, until all the munjestine was extracted.

It is precipitated from the aqueous solution by bromine water, and the precipitate dried, if carefully heated, can be sublimed into beautiful golden lustrous scales and crystals, in the shapes of broad flat needles. It is convertible by the action of nitric acid, into phthalic acid, like purpurine and alizarine. A most beautiful orange-colored precipitate is obtained by mixing the watery or alcoholic solution of munjestine and acetate of lead. A slight excess of lead makes the precipitate scarlet.

The following extract from the "Proceedings" alluded to, shows the results of a comparison of "manjit" and European madder.

PROFESSOR RUNGE stated, in 1835, "that munjeet contains twice as much available coloring matter as the best Avignon madder. This result was so unexpected, that the Prussian Society for the Encouragement of Manufactures, to whom PROFESSOR RUNGE'S memoir was originally addressed, referred the matter to three eminent German dyers, MESSRS. DANNENBERGER, BÖHM AND NÖBILING. These gentlemen reported, as the result of numerous and carefully conducted experiments, that so far from munjeet being richer in coloring matter than ordinary madder, it contained considerably less. This conclusion has been confirmed by the experience of my friend, MR. JOHN THORN, of Birkacre, near Chorley, one of the most skilful of the Lancashire printers.

"From a numerous series of experiments I have just completed, I find that the garancine from munjeet has about half the tinctorial power of the garancine

made from the best madder, viz., Naples roots. These, however, yield only about 30 to 33 per cent. of garancine, while munjeet, according to my friend, MR. HIGGIN, of Manchester, yields from 52 to 55 per cent. Taking the present prices therefore of madder at 36 shillings per cwt., and munjeet at 30 shillings, it will be found that there will be scarcely any pecuniary advantage in using munjeet for ordinary madder dyeing. The colors from munjeet are certainly brighter, but not so durable as those from madder, owing to the substitution of purpurine for alizarine. There is, however, great reason to believe that some of the Turkey red dyers are employing garancine for munjeet to a considerable extent. When this is the case they evidently sacrifice fastness to brilliancy of color. By treating such a garancine with boiling water, and precipitating by an acid in the way already described, its sophistication with munjeet may very readily be detected. The actual amount of coloring matter in munjeet and the best madder is very nearly the same; but the inferiority of munjeet as a dye stuff results from its containing only the comparatively feeble coloring matters, purpurine and munjestine, only a small portion of the latter being useful, whilst the presence of munjistine in large quantity appears to be positively injurious. So much is this the case, that when the greater part of the munjestine is removed from munjeet garancine by boiling water, it yields much richer shades with alumina mordants than before."

An application of madder has been made to the preparation of *Garancine*. The process appears so valuable, that it might be carried out in the Punjab. An account of the method is extracted from DR. URE'S Dictionary, Vol. III.

"It was supposed by ROBIQUET, that by the action of sulphuric acid on madder, the saccharine, mucilaginous, and extractive matters of the root were destroyed, and thus hindered from producing any injurious effects in dyeing, and that the woody fibre was at the same time charred, so as to prevent it from attracting and binding any of the coloring matter. This explanation is not entirely correct, since it is not necessary to carry the action so far as actually to carbonise any of the constituents of the root, and it is also doubtful whether the woody fibre ever attracts the useful coloring matters in any considerable degree. The account above given of the chemical constitution of madder, may easily lead us to the conclusion, that, during the action of the acid, the following processes take place:—1, The bitter principle or color producing body of the root is decomposed, yielding among other products, a quantity of alizarine, which did not previously exist; 2, The red coloring matters are rendered by the acid insoluble in water, and, thus it becomes possible to wash out the extractive matter, sugar, &c., without the madder losing any of its tinctorial power; 3, The lime, magnesia, and other bases which are combined in the root with coloring matter, or would combine with it during the dyeing process, are removed by the acid, and thus prevented from exerting any injurious action. The subsequent addition of a suitable quantity of lime, soda, or other base, serves to neutralise the effect of the excessive amount of pectic acid and resinous coloring matters, which were set free by the action of the mineral acid.

"The method of manufacturing garancine, as practised at the present day, may be shortly described as follows:—The ground madder is mixed with water, and the mixture is left to stand for some hours. During this time it is probable that the rubian is decomposed by the ferment of the root, otherwise, a great loss would be experienced. More water is now added, in order to remove all the soluble matters, and is then run off. The liquid contains sugar, and is employed on the Continent for the preparation of a kind of spirit, which, on account of its peculiar smell and flavor cannot be consumed as a beverage, but is used in the arts for the preparation of varnishes and other purposes. A sufficient quantity of alcoholic spirit is thus obtained to pay for the whole cost of the process. The residue left after washing the madder may be employed for dyeing without any further preparation, and is then called 'fleur de garance.' In order to convert it into garancine, it is mixed with sulphuric acid, and the mixture is heated and left to itself for some time. Water is then added in successive portions until the excess of acid is removed. The pectic acid of the root always retains a portion of the sulphuric acid in chemical combination; and the compound being but little soluble in water, would require for its removal a very long washing. The addition of a small quantity of carbonate of soda, by neutralising this double acid, serves to abridge the time of washing very considerably. The residue is then filtered on strainers, pressed, dried, and lastly, ground into a fine powder. This powder has a dark reddish brown color, and a peculiar odour, different from that of madder, but no taste. It communicates hardly any color to cold water. Dyeing with garancine is attended with the following advantages:—1, The whole tinctorial power of the madder is exerted at once, and garancine is therefore capable of dyeing more than the material from which it is made; 2, The colors produced by its means are much brighter than those dyed with madder, and the parts of the fabric destined to remain white attract hardly any color, so that very little treatment is required after dyeing; 3, Much less attention is required in regard to the temperature of the dye-bath and its gradual elevatiou

than with madder, and a continued ebullition produces no injurious affects, but only serves to exhaust the material of all its coloring matter. On the other hand, garancine colors are not so fast as madder colors, they do not resist so well the action of soap and acids, and hence garancine cannot be employed for the more permanent colors, such as pink and fine purple. By the use of a product which was patented by PINCOFFS and SCHUNCK several years ago, and which is obtained by exposing garancine to the action of steam at high pressure, it is indeed possible to dye as beautiful and as permanent a purple as with madder, and its use is attended by a considerable saving of time, as well as of dyeing material and soap, but it is not so well adapted for dyeing pink. As yet, therefore, we have not succeeded in obtaining a preparation which shall serve as a perfect substitute for madder, and the latter, consequently, continues to be employed for some purposes."

The samples of madder exhibited were from—

(4478) Jálandhar.
(4530) Amritsar.
(4558) Lahore.
(4642) Dera Ismáíl Khán.
(4648) Dera Ghází Khán.
(4658) Peshawur.
(4665) Kashmír.

All these were imported from Kandahár. One indigenous specimen was sent by the REV. MR. JAESCHKE from Lahaul (4507); only one sample came from the bazars of Kangra and Simla, though madder is to be obtained there; it is, however, seldom, if ever, exported from these places to the plains. The madder mostly goes to Múltán, and thence is dispersed over the country.

1668.—[4450]. "Al," root of *Morinda tinctoria*. Philibít. LOCAL EXHIBITION COMMITTEE OF GURGAON.

This is a root allied to the species of *Rubia*, and gives a red dye; as do also *Morinda augustifolia*, *citrifolia*, &c., in Central India.

In the Deccan, the "chay" root, *Hedyotis umbellata*, is celebrated. A sample was sent from Madras.

It is the "chay" root that is said to have been used in the original process of dyeing what is called Turkey red, but now the cotton fabrics dyed in this way are all imported from Manchester and Glasgow.

In the Madras Presidency, a process very similar to the Glasgow process is in vogue: and as the same style of dyeing can be practised with madder, the process appears of sufficient importance to be noticed here. The account is copied from the Appendix to the Madras Jury Report on Dyes, at the Exhibition of 1857.

Red.—Native process for dyeing red with "chay" root, calculated for 1 viss (or 3½ lbs.) of white twist—

Take of sweet oil,	.. ..	6 pollums
Ashes of the milk hedge (*Euphorbia antiquorum*),	..	6 „
Sheep's dung,	.. .. ..	3 „

mix and keep in an earthen vessel for the space of four or five years, the older it is the better. Then when about to commence the process of dyeing, to the above mixture add

Fresh ashes of milk hedge,	..	8 measures
Spring water,	.. .. ..	4 „

mix and strain and add to the strained fluid, shake the whole well together, and then add

Sweet oil,	.. .. ..	15 pollums
Sheep's dung,	.. .. ..	15 „
Spring water,	.. .. ..	1 measure

mix the whole in a vessel. Then steep the twist in it for an hour, pressing and squeezing it well with the hands to cause it to absorb the fluid fully, after which leave it to soak. On the following day remove the twist and dry it in the sun. Then take in a vessel afresh

Ashes of milk hedge,	.. ..	6 measures
Spring water,	.. .. ..	3 „

mix and strain, and add to the strained fluid

Sweet oil,	.. .. ..	15 pollums

Shake the whole well together and steep the thread in it for an hour, using the hands as before described, leave it to soak all night. Next morning take out the thread and dry it in the sun. In the evening of the same day take in a vessel afresh

Ashes of milk hedge,	.. ..	6 measures
Spring water,	.. .. ..	3 „

mix and strain, to which water add

Sweet oil,	.. .. ..	7½ pollums

steep the thread in the mixture, using the hands as before and leave till next morning. Then remove and dry in the sun. Next take afresh

Ashes of milk hedge,	.. ..	3 measures
Sweet oil,	.. .. ..	3¾ pollums
Spring water,	.. .. ..	3 measures

mix and steep the thread, using the hands as before, and leave it soaking until next morning, when remove and dry in the sun, take afresh

Ashes of milk hedge,	.. ..	3 measures
Sweet oil,	.. .. ..	3¾ pollums
Spring water,	.. .. ..	3 measures

mix and steep in as before until next morning, then take afresh

Ashes of milk hedge,	.. ..	1½ measures
Sweet oil,	.. .. ..	1¾ pollums
Spring water,	.. .. ..	2½ measures

mix and follow the process as before, and take afresh

Ashes of milk hedge,.. .. 1 measure
Sweet oil, ... $\frac{1}{16}$ pollums
Spring water, ... 2 measures
mix and follow the process as before, then take afresh
Ashes of milk hedge,.. .. ½ measure
Sweet oil, ... ½ pollum
Spring water, ... 2 measures
mix and follow the process as before, dry the thread for three days in the sun; on the foruth day take afresh
Ashes of milk hedge,.. .. 3 measures
Sweet oil, ... 2½ pollums
Spring water, ... 3 measures
mix and follow the process as before, but dry the thread in the *shade* the same night. Then take afresh before noon next day
Ashes of milk hedge,.. .. 1½ measure
Sweet oil, ... 1½ pollum
Spring water, ... 2 measures
mix and strain, then steep the thread in the strained fluid a whole day and night, remove the thread next day, and expose it in the sun for four days. Then leave the thread untouched for a whole month, and after the expiration of that period, expose it for a day to the sun. On the day following wash the twist in pure spring or river water, and on the evening of the next day, take in a vessel afresh

Spring water, .. 10 measures } mix
Pounded "alli" leaves, 4 „ } and add
Powder of "chay" root, 1½ „

mix the whole, steep the thread in the mixture, using the hands as before, and leave to soak for the night. On the following morning, wash the thread in pure water and leave to dry.

The above process to be repeated afresh for the seven following evenings, omitting the "alli" leaves after the first two days. On the 8th day, in the morning, allow the thread in the mixture to boil, say from 4 to 8 P.M., then remove and keep the thread in the vessel *covered* until next morning, when remove the thread and wash it in pure water, leaving it to dry in the shade for a whole day. Repeat the washing and drying for the four following days. On the fifth day take afresh

Ashes of milk hedge,.. .. 3 measures
Spring water, ... 3 „
Sheep's dung, ... 3 pollums
Sweet oil, ... 2½ „

mix, steep the thread, using the hands as before, and then take it out to dry. A similar course must be followed for the three succeeding days, then keep it quite one day; on the following day wash the thread in good water, and leave to dry, all next day, then take afresh

Powder of "chay" root, .. 5 pollums
Spring water, ... 10 measures

mix, steep the thread, observing the same process as before, next morning remove the thread, and wash it in good water, and leave to dry, following a similar course for three days; then keep the thread quiet for ten days, after which take afresh

Ashes of milk hedge,.. .. 3 measures
Sweet oil, ... 2½ pollums
Spring water, ... 3 measures

mix, steep the thread, observing the same course as before, and leaving it till next day, then dry it in the shade, and follow the same procees three days, then leave it for ten days, after which wash in good water, and take afresh

Powder of "chay" root, .. 5 pollums
Spring water, ... 8 measures

mix, steep the thread in the mixture, using the hands as before, and dry in the sun next morning. Repeat the same the three following days, then on the succeeding morning wash the thread well in good water and when dry, it will have attained a beautiful fast red color, ready for weaving purposes.

1669.—"Bakm," sappan wood (*Cæsalpinia sappan*); also called "vakm," and "patang."

A colored wood, imported almost exclusively from Bombay. It yields pinks and reds, and lilacs, but not permanent.

Samples are sent from—
(4451) Gurgaon (this comes however from Philibit).
(4484) Jálandhar.
(4531) Amritsar.
(4562) Lahore.

The Brazil and Nicaragua woods, used in making red ink, are allied species.

1670.—[4509]. Kuámé, a red dye, from Lahaul. Rev. Mr. Jaeschke.

This is a black tapering root like a parsnip, with rough glabrous leaves, and is referred to *Onosma echioides*. Is very like the allied genus *Anchusa*. It is used medicinally for wounds and diseases of the blood, and in certain religious ceremonies. Not officinal in Lahaul as a dye.

From Madras was exhibited a lilac red ink of pleasing color, from species of prickly pear, and a pot of a concrete red dye obtained from the same; and a specimen of the "chay" root (*Hedyotis umbellata, Oldenlandia umbellata*).

1671.—[ ]. Kussumba, "gul-i-másufír," safflower, bastard saffron (*Carthamus tinctorius*).

This dye is grown for local consumption in several districts, but the best comes from the hills. The

city of Dínanágar, in Gurdaspúr, is celebrated for its "kussumba" dyes; and excellent "kussumba" is grown in the submontane portions of Kangra, Gurdaspúr, and Hushyarpúr: the hill safflower is quite the best.

The Lahore dyers acknowledge three kinds—the first distinguished by the bright clear color of the flowers, his is "pahárí." The second is "Hushyarpúrí;" and the third "Gujrátí." "Kussumba" is sold both powdered and unpowdered. In Bengal the flowers are steeped in water till all the first, or yellow coloring, matter is extracted: and then the flowers being ready to give the second, or valuable red coloring matter, are compressed into cakes and dried.

It is much to be regretted that science has hitherto failed to produce any substance capable of fixing the beautiful tints of the safflower. Consequently, articles dyed with the flower will alter and fade after a time in the light.

In Europe a species of rouge is obtained by precipating an impalpable powder from the solution of safflower; in this country, pinks and reds are produced of all shades, from the pale "piyazí" or pinkish white, to "gulábí," bright pink, and to the crimson, "gul-i-shaftalú" color.

Samples of "kussumba" are sent from the following districts:—

(4440) Delhi (powdered and unpowdered).
(4447) Gurgaon.
(4457) Rotak.
(4460) Ambálah.
(4472) Bhajji of Simla.
(4468) Ludhiana.
(4496) Kangra.
(4479) Jálandhar.
(4526) Amritsar.
(4459-61) Lahore (of the three varieties just noticed).
(4587) Gujranwalla.
(4609) Jhilam.
(4620) Gugaíra.
(4635) Jhang.
(4637) Muzaffargarh.
(4641) Dera Ismaíl Khán.
(4649) Dera Ghází Khán.
(4654) Bunnoo.
(4661) Peshawur (from Kábul).
(4662) Kapúrthalla.
(4679) Jhínd.
(4681) Nabha.
(4684) Pattiala.

1672.—Harsinghár, the flowers of *Nyctanthes arbortristis.*

Grows on some of the hills, and is used for dyeing, silks especially; it produces a good yellow color, and compounds with reds, into a pleasing series of flame, salmon, and orange colors.

Samples came from—

(4439) Delhi.
(4443) Gurgaon (Jharsah).
(4462) Ambálah.
(4619) Gugaíra.
(4685) Pattiala.

1673.—Phúl tún, flowers of *Cedrela toona.*

Also yield a yellow dye of little permanence.

The samples are from—

(4465) Ambálah.
(4499) Kangra.
(4527) Amritsar (imported).
(4549) Lahore.
(4586) Pattiala.

1674.—"Gul kesu," flowers of the dhák or palás tree *(Butea frondosa).*

These are large papilionaceous yellow and orange flowers, having a very handsome appearance: there are in parts of Karnál whole jungle tracts covered with this tree, and the masses of flowers must present a brilliant appearance. The flowers are ground into powder to make the "roli," or colored powder which Hindús throw at one another during the "holi," or spring festival; or are boiled, and the color extracted and precipatated for the purpose. The color, as a dye, is bright, but not fast. Specimens scarcely differing in appearance were sent from—

(4458) Rohtak.
(4461) Ambáláh.
(4491) Jálandhar.
(4498) Kangra.
(4588) Gujranwalla.
(4591) Gujrát.
(4606) Jhílam.
(4613) Shahpúr.
(4613) Gugaira.
(4650) Dera Ghazí Khán.
(4664) Kapúrthalla.
(4677) Kashmír.

1675.—"Aswarg" or "asbarg," "isbarg."

Is a yellow dye, being the stalks and flowers of a species of *Delphinium.* It is almost exclusively used in dyeing silk, to which it gives a fine yellow, not permanent. The dye is exclusively imported from Khurasán and and Kábul.

(4528) Amritsar.
(4657) Peshawur.
(4555) Lahore.

1676.—[ ]. Saffron, the stigmata of the flowers of *Crocus sativus*.

Samples are sent from Kashmír and from Dera Ismaíl Khán (4640), which last is probably imported from Kandahár and Persia, where saffron is largely grown. "Bakiri" saffron comes from Kandahár. The plant is more used in confectionery and medicine than in dyeing.

The following extract describes the cultivation in Kashmír :—

"Pampur, a large village on the right bank, is celebrated for its saffron grounds. The cultivation of the flower is carried on in nearly every part of this pergunnah, the local soil being alone found suited for the purpose: it appeared to consist of a light ferruginous clay, which is excavated near the Jhilam, and carried to the fields by great manual labor. The bulbs are planted out in small square beds in June, weeded and freely irrigated, and the crop is collected in October. The MAHARAJA and his myrmidons attend the gathering, and take the *spolia opima* of the occasion. The drug is sold in the royal bazar: and I was informed that 1 rupee per seer was levied as an export duty on the trade. It varies in price according to quality: I observed some as low as rupees 5 the seer of 2 lbs., but this was mixed with very ancient stuff or what was worse, the *dried petals* of the flower. True saffron *(under royal warranty)* fetches from 7 to 10 rupees per seer, in Kashmír coin, which is little more that half the "Company's." Steeping the article in water previous to weighing out is commonly practised, and which, in addition to increasing weight, injures its coloring properties irretrievably. Sometimes the unwary Hindústání merchant packs it in this damp state, and on reaching the plains discovers, to his great sorrow, that the precious purchase has become a mass of mouldy rubbish, unsaleable at a pice."*

1677.—[4476]. Berberry (*Berberis aristata*). Simla. MR. GEO. JEPHSON.

The wood yields a yellow principle, which is called berberine. This is also the "yellow wood" of the Bunnoo collection, from the Wazírí hills (4655). There is an interesting paper on this product by PROFESSOR SOLLY, extracted in Vol. III. of A. H. Society's Journal; the early volumes of the series are so rare, that I have reproduced the paper *in extenso*.

On the yellow color of the Barberry, and its uses in the Arts. BY E. SOLLY, ESQ.—"Having learnt, whilst engaged in enquiries amongst manufacturers and other practical men, that the root of the common barberry (*Berberis vulgaris*), was an article of increasing value in the arts, on account of the fine yellow color which it contains, and that a new source of this dye stuff was rather a desideratum, I was led to inquire in how far the root in question could be advantageously obtained from India.

"The most important use to which the coloring matter is applied, is, as I am informed by a gentleman well acquainted with the arts of dyeing, for the purpose of dyeing or staining leather yellow, for which purpose it is found peculiarly well suited.

"The coloring principle is found in the bark and wood of the stem, as well as in the root; but the root only has, I believe, been applied in dyeing. In the specimens which I have seen, the coloring matter was in the stem for the most part collected together in the bark, and round the circumference; a considerable portion, also, was deposited round the pith, particularly in the larger stems; whilst the great bulk of the woody fibre intervening, contained very little color. The root, however, was wholly of a fine yellow color.

"The gentlemen, before mentioned (and to whom I am indebted for much useful information on this subject), informs me, that the barberry he has seen was generally in large straight pieces, having a somewhat honey-comb cellular structure, and that the color was generally collected together as it were in masses.

"In the larger stems, the proportion of useless woody fibre to the bark and parts yielding color, is undoubtedly large, but this is quite compensated by the superior richness of color in the old stems.

"According to some experiments of MM. BUCHNER and HERBERGER, which are detailed in the 'Journal de Pharmacie,' the root of the *Berberis vulgaris* contains rather more than 17 per cent. of yellow coloring matter, which is entirely soluble in hot water, and to which the name of berberine has been applied. The root, besides this, contains gum and many other substances, but it is the berberine alone which is available for the purposes of the dyer.*

"Few natural orders are more widely distributed than the *Berberideæ*, for they are found in most temperate parts of the globe: species are found in most of the countries of Europe; and extend, as DE CANDOLLE has observed, from Candia to Christiania. In Asia, they are, perhaps, even more widely diffused

* "Natural Productions of Kashmir." LIEUT. LOWTHER, Journ. As. Soc. VIII., p. 224.

* This color has been long used in Astrachán and Poland as a dye for leather, and in some parts of Germany, for staining wood of a bright yellow color.

and abundant. The best known varieties of Asiatic barberries are—

"1. *Berberis Siberica.*—A small shrub found on the lower mountains and rocky hills of Altaic Siberia.

"2. *Berberis sinensis.*—Which abounds in China, and the northern parts of India.

"3. *Berberis Wallichiana.*—A native of Nepal.

"4. *Berberis floribunda.*—This plant, which is common in the whole of the North of India, was formerly thought by DR. WALLICH to be identical with *Berberis aristata;* it is now, however, known to be different.

"5. *Berberis Asiatica.*—Abundant in Nepal and Kumaon; and according to DE CANDOLLE, the *Berberis tinctoria*, which flourishes in the Neelgheeries, is identical with this species.

"6. *Berberis aristata.*—Perhaps the most widely diffused of all these species. It abounds in the mountains of Northern India, and extends from the Himalaya mountains to the Neelgheeries, and as far south as Nuera Ellia, and Adam's Peak in Ceylon. It has been described in the 'Botanical Magazine,' under the name of *Berberis chitra;* it is, however, not the same as the *Chitria* of Nepal, which is another variety of *Berberis.*

"Many of these species live for a long series of years, and attain very considerable size; according to DR. ROYLE, *Berberis Nepalensis*, a most beautiful species, which inhabits the mountainous districts in the North of India, grows in shady places to the height of 12 feet, at elevations of from 5 to 6,000 feet above the level of the sea; and M. LESCHENAULT DE LA TOUR states, that the *Berberis tinctoria*, which flourishes in the Neelgheeries, and is there known by the name of 'jakalow,' attains a height of even 20 feet.

"These different species of *Berberis* are employed by the natives in the districts where they abound, in medicine, and as a dye; and the fruit of some are dried and used as an article of food. The late GENERAL T. HARDWICKE, in his 'Narrative of a Journey to Sirinagar,' published in the 'Asiatic Researches,' relates that a variety of *Berberis* is abundant in the valley through which the Koa Nullah has its course; the fruit of this variety is eaten by the natives, and the wood, which is of a bright yellow color, is used by them for dyeing, but from the imperfection of their processes the color so obtained is not permanent. DR. ROYLE, in his 'Illustrations of the Botany and Natural History of the Himalaya Mountains,' says, when describing the properties and uses of the *Berberidaceæ*. 'The root and wood of one species, the *Berberis aristata*, being of a dark yellow color, and forming the 'dar huld' of Persian writers, are used as a dye; and being bitter and a little astringent, are, together with the bark, employed in medicine.' The variety of *Berberis* found in the Neelgheeries, and which M. LESCHENAULT DE LA TOUR calls *Berberis tinctoria*, from the use to which it has been applied, has by the experiments of MR. VAUQUELIN, been found to be inferior to few woods, for dyeing a yellow color.

"There being fortunately preserved in the Museum of this Society, a small quantity of barberry root, which had been sent from Ceylon, together with other specimens of dye woods, &c., I have been enabled to make some experiments with its coloring matters, the result of which proved that it was quite as abundant in the Asiatic as in the European barberry; and on comparing it with some root from Cologne, I found that the color from the Asiatic was even finer and more brilliant; and from some experiments in dyeing cotton and silk with it, I have no doubt that it will be found, if not superior, at least quite equal to the very best which has hitherto been obtained from Cologne, Hamburg, and some other European towns.

"Experiments should be made as to the relative quantity and quality of color contained in the old and young trees, and in their wood, bark, and roots respectively, and likewise as to the best time for collecting them.

"As the root contains only about 17 per cent. of useful coloring matter, and the remainder consists of woody fibre and other matters not useful to the dyers, it is important to inquire into the possibility of substituting for the wood or root a watery extract of them. This would contain the whole of the coloring matter, and whilst it would present it in a condensed and convenient form, would of course greatly diminish the expense of carriage and freight, and, in consequence, reduce the ultimate cost of the color.

"It is evident that there would be no great difficulty to prevent this being done, for the natives prepare extracts with great success, and have considerable experience in such operations, as we see from a number of Indian extracts, such as "kath" and *Terra japonica*, which have lately become important articles of trade. But there would be far less difficulty in obtaining the extract of barberry, than that of many other trees, for the natives have long made and used it themselves as a medicine; and it is described in the Asiatic books on Materia Medica, under the name of 'rusot,' 'hoozis,' and 'huzuz.' There can therefore be no difficulty in obtaining the article in any quantity which may be required.

"It has long been remarked, as a curious circumstance, that DIOSCORIDES has made no mention of the barberry, which, from its wide diffusion and remarkable properties, could hardly escape the attention of

the early naturalists. This has, however, been explained by DR. ROYLE, who has adduced the most unexceptionable evidence to prove that the Lycium of the ancients, or *Λύκιον* of the Greeks, was really identical with the 'hoozis' of the present day, and was in fact, an extract of barberry. A very interesting confirmation of this will be found in AVICENNA, who, when speaking of Lycium, says it is the extract of 'Al-Feluzhargi;' and DR. ROYLE, in his paper on Lycium, informs us, that the Persian name of 'rusot,' the extract of barberry, is 'Feelzurch.'

"Some little confusion is caused by the term 'dar huld,' or yellow wood, being applied to more than one plant; thus, among many others, PLAYFAIR, in his translation of the 'Talif Sherif' describes 'dar huld' as turmeric, and says, it is pungent, bitter, hot, and dry, a description applicable to turmeric, but not at all to barberry, which is usually described as bitter, cooling, and slightly astringent; and DR. ROYLE informs us, that in the North of India 'dar huld' signifies barberry, and that on asking to see the plant yielding 'dar huld' and 'rusot,' species of *Berberis* were pointed out; whilst in the South of India it is only applied to turmeric.*

1678.—Ekal bír, roots of *Datiscus cannabinus*.

Exclusively a hill product, and used in dyeing silk pale yellow, it is also an ingredient in producing a pleasing pale "pista green."

A specimen is sent from

(4505) Kangra.
(4676) Kashmír.
(4481) Jálandhar.

1679.—[4606]. Akás bel (*Cuscuta reflexa*). Jhilam. LOCAL COMMITTEE.

This plant is a thread-like parasite, often hanging over bushes; it is only occasionally used in dyeing.

1680.—Kamíla. The red powder from the capsules of *Rottlera tinctoria*.

Hill produce.

Samples are sent from—

(4470) Ludhiana.
(4500) Kangra.
(4543) Amritsar.

1681.—Turmeric, (*Curcuma longa*); "haldi;" "zardchob."

For an account of this plant, *see* under "Spices and Condiments." The sorts that are best for dyeing are less good for eating, and *vice versâ*. Turmeric is liable to instant discoloration by all alkalies, of which it is a test, hence it is a bad and unpermanent dye stuff.

Samples of the dye were sent from—

(4497) Kangra.
(4529) Amritsar.
(4537) Lahore.
(4644) Dera Ismaíl Khán.
(4656) Bunnoo.

1682.—Mendhi or barg-i-haná (*Lawsonia inermis*).

Used rather as a dye for the beard and hair, and for fingers, and for horses' tails, than as a fabric dye.

Some classes of Mahomedans esteem red hair a great beauty, and dye with "mendhi" accordingly; if a black hair dye is required, "mendhi" with myrtle berries is first applied, and over that indigo, producing a purple-black. The practice of staining the finger nails with this drug is not uncommon among women. The best "mendhi" comes from Gujranwalla.

Samples are sent from—

(4463) Ambálah.
(4554) Lahore (tahsil Chúnyán).
(4589) Gujranwalla.
(4615) Shahpúr.
(4687) Pattiala.
(4449) Gurgaon.

Memorandum on the cultivation of the "mendhi" plant (Lawsonia inermis). BY MAJOR W. G. DAVIES, Deputy Commissioner of Shahpúr.—"This plant, so often seen in our gardens as an ornamental hedge, is extensively cultivated about Bhera, in the Shahpúr district, for the sake of the dye extracted from its leaves, which, dried and reduced to powder, forms a regular article of commerce. The mode of cultivating it here is as follows:—The soil is prepared by repeated ploughings not less than sixteen, and heavy manuring. Before sowing, the seed is allowed to soak in water for twenty-five days. It is then spread on cloth and allowed to dry partially. The plot of land in which it is proposed to grow the 'mendhi,' is then formed into small beds, and some days before sowing these, are kept *flooded*. The seed is scattered on the surface of the water, and with it sinks into the ground. For the first three days after sowing, water is given regularly night and morning, after that only once a day. The young plant first shows above ground on the fifteenth day, after which water is only given every other day for a month, when it is supplied at intervals of three days, and this is continued for another month, by which time the plants have become nearly two feet high. They

* "Journal of the Royal Asiatic Society of Great Britain and Ireland," No. XIII.

are now fit for transplanting. The mode of conducting this operation is as follows:—The young plant on being taken out of the ground is reduced by nipping off about six inches from the centre shoot. After having been subject to this treatment, the young plants are singly put into holes previously dug for them at distances of about a foot from each other. They are then watered daily until they have recovered the shock of transplanting, and afterwards as they may require it. The fields are weeded regularly once a month. The first year nothing is taken from the plants, but after that they yield for years, without intermission, a double crop. At each cutting, about nine inches is taken from the top shoots of the plants. The two crops are gathered in Baisakh (April and May) and Katak (October and November) of each year. The laborers employed in planting out the *mendhi*, instead of receiving their wages in money, are liberally fed as long as the operation lasts, and a distribution of sweetmeats takes place when it is over. The season for sowing is during the month of Baisakh, that of transplanting, Sáwan (July and August). A year's produce of an acre of well grown 'mendhi,' is twenty maunds of dry leaves, of which about six maunds are gathered in the spring, and the rest during the autumn months; and the same plants continue to yield for twenty or twenty-five years.

"The selling price of the leaves averages a rupee for twelve seers, so that the value of the crops per acre is about 66 rupees. After the first year, the expenses of cultivation do not much exceed those of other crops. The produce of the 'mendhi' grown in this district is nearly all carried across the Jhilam, and sold in the northern districts, none of it finds its way to the south. Besides, the use to which the leaves are ordinarily put, viz., as a dye for the hair, hands, &c., they are also given to goats and sheep, &c., when attacked by itch."

1683.—[4536]. Gul-i-zard. Amritsar. LOCAL COMMITTEE.

I have no information respecting the Botanical origin of the flower.

1684.—[4607]. Harmal (*Peganum harmala*). Jhilam.

Used in dyeing black. The seeds of this plant are attracting attention in Europe as a brown and black dye. The plant grows everywhere on waste broken ground in the Punjab, and might be collected at a very cheap rate, except perhaps as regards carriage; but the subject wants attention.

The next series are those vegetable (1) astringents, and (2) acids, which are used as brighteners and mordants. The mineral ones, the principal of which are alum, and the varieties of "kahi" have been referred to in the Mineral Department (*see* also the Jury Report).

1685.—Naspál, rind of the pomegranate (*Punica granata*).

Besides its astringency, this is itself used alone as a dye, giving a somewhat feeble yellow. The bark of the tree "post anár" is also powerfully astringent, but is not common enough to be much in use as a tanning agent.

Samples were sent from—
(4445) Gurgaon (Jharsah).
(4456) Rohtak.
(4483) Jálandhar.
(4561) Kangra.
(4533) Amritsar.
(4557) Lahore.
(4610) Jhilam.
(4614) Shahpúr.
(4618) Gugaira.
(4639) Muzaffargarh.
(4652) Dera Ghází Khán.
(4707) Pattiala.

1686.—Máíń, galls of *Tamarix furas* and *T. dioica*.

These are used in dyeing with madder, the cloth being first steeped in a solution of the galls. They form also with "kahi," the salts of iron, various shades of "kháki" or gray, and darker shades, and up to black: they are also used in tanning.

They abound in all jungly districts where there are tracts of waste land covered with the tamarisk, as in Gugaira, Jhang, &c., &c. In Dera Ghází Khán, MAJOR POLLOCK mentions that 500 maunds were annually collected.

The dyers sometimes make a distinction between "máín barí" and "máín choti," but there is no reason to suppose there is any difference in the nature of the product, the only difference being in the size of the galls.

This must not be confounded with the "mainphal" (*Randia dumetorum*).

Specimens of "máíń" were sent from—
(4445) Gurgaon.
(4490) Jálandhar.
(4541) Amritsar.
(4612) Shahpúr.
(4616) Gugaira.
(4639) Muzaffargarh.
(4651) Dera Ghází Khán.
(4634) Jhang.

1687.—[4670]. Májú. Srínagar. H. H. THE MAHARAJA.

The fruit or nuts of *Cupressus sempervirens*, or allied species. The Májúphal is *usually* a gall imported *viâ* Calcutta, and probably an oak gall: none of the Indian oaks have galls.

1688.—[4676]. Rál (resin). H. H. THE MAHARAJA.

Used in dyeing wools of a silver and dove color.

1689—[4669]. "Darengri." Srínagar. H. H. THE MAHARAJA.

The astringent leaves of a tree (*Rhus cotinus* or allied species?) used in dying with "kahi" to produce black and gray shades.

1690.—[4666]. "Dhoń patta," leaves of the *Conocarpus latifolius*. Jammú. H. H. THE MAHARAJA.

A sample was sent also from Kangra (4502).

The leaves are astringent.

1691.—[4671]. "Ushna," lichen (*Borrera ushua*). Srínagar. H. H. THE MAHARAJA.

Used in dyeing.

1692.—[4487]. Har (*Beleric myrobalan, Terminalia bellerica*). Jálandhar. LOCAL COMMITTEE.

These trees are extensively grown in the Kangra district of this division, and this district is probably the source of the sample.

MR. BARNES writes: "These trees are very valuable. The produce of a single tree will sometimes sell for Rs. 2,000. The "hur" flowers in May. The fruit ripens in October or September, and consists of a nut enclosed in a thin exterior rind. The rind is the valuable part. It is used as an aperient, and has also tonic properties calculated to promote digestion. It also forms a dingy yellow dye.

"The fruit is exported by traders from the plains, who generally contract for each tree, according to the produce it bears. The larger the fruit, the more active its medicinal qualities. One nut will sometimes sell for one rupee. The ordinary price however is ten or eleven seers for a rupee."

1693.—[4402]. "Balela súja h," small black *Myrobalan* (*Terminalia citrina*). Jálandhar. LOCAL COMMITTEE.

1694.—[4503]. "Aṁwlá patta." Kangra. LOCAL COMMITTEE.

The skin and rind of the *Emblic myrobalan* (*Emblica officinalis*).

1695.—[4506]. A'mlah leaves. Kangra. LOCAL COMMITTEE.

The leaves of the same tree.

1696.—[4510]. "Púrlú." Spiti. KANGRA LOCAL EXHIBITION COMMITTEE.

A substance used in dyeing black with "pasúta" (alum and sulphate of iron) as the mordant. It is the astringent twig of a tree.

1697—[4510]. Nayálu. Spiti. KANGRA LOCAL EXHIBITION COMMITTEE.

An astringent: used in dyeing red and yellow.

1698.—[4544]. Boz gand, galls of *Pistacia terebinthus* or *P. cabulica*. Amritsar. LOCAL COMMITTEE.

Used in dyeing. They are brought from Kábul, &c.

ACID SUBSTANCES ADDED TO BRIGHTEN THE TONE OF DYES.

1699.—[4453]. "Am chúr," dried slices of unripe mangoes. Rohtak. LOCAL COMMITTEE.

A sample also was sent by—
(4489) Jálandhar.
(4494) Kangra.

1700.—[4454]. Limes (*Citrus medica*). Rohtak. COL. VOYLE.

These are used in dyeing with "kussumba." A sample of the juice was sent also from Kangra (4495).

1701.—[4493]. Galgal juice (*Citrus galgala*). Kangra. LOCAL COMMITTEE.

1702.—[4455]. Tamarind, "imlí" (*Tamarindus indica*). Rohtak. COLONEL VOYLE.

These are the fruits dried: they are very acid. This fruit is too uncommon to be of general use in dyeing.

1703.—[4484]. Kishtah.

These are dried pieces of unripe apricots, brought from the hills and from Kábul, &c. Its acid is used extensively in dyeing with "kussumba," but is also valued to make chutnies and pickles of. A sample was sent from Lahore (4550).

1704.—[4488]. Soap nut, haritha (*Sapindus emarginatus*). Jálandhar.

Used in dyeing and washing shawls, silks, &c.
(4672) Kashmír.

There are also in the dye list two unidentified names.

1705.—[4542]. Akbíj. Amritsar.

1706.—[4545]. Harkadi. Amritsar.

ARTISTS' COLORS.

The great majority of these are mineral: there are only two or three in the Vegetable Kingdom.

1707.—[4515]. Peori. Amritsar. Local Committee.

This is a precipitate, collected and dried from the urine of cows, which have been fed on mango leaves. This "peori" is called "hardwárí." "Wilayiti peori" is chrome yellow (chromate of lead).

1708—[4524]. "Khún siáwashán," dam-ul-akhwain *(Ar.)* Amritsar. Local Committee.

Dragon's blood, not from the *Dracæna draco*, but probably a *Pterocarpus*. The gum resin ground up yields a good transparent pink and red.

1709.—[4521]. Rola. Local Committee, Amritsar.

This is an artificially colored powder made of the *Trapa bispinosa* flour, colored with "kussumba," and "kamela," &c.; it is used by Hindús during the carnival, or "hulí" festival, to throw at one another.

Under this class were exhibited several samples of dyed threads, silks and woollens, as well as fabrics. There were one or two samples of calico, printed in colors, and in silver and gold; but the finest samples of prints were exhibited as manufactured fabrics, in the section devoted to textile goods.

1710.—[4442]. A book of dyed cloths was exhibited by the Municipal Committee, Delhi.

These dyes were as follows:—

Halki piyázi—pink, very pale.—Made with kussumba.

Piázi (onion)—pink.—Ditto.

Gulábí (rose)—bright rose color.—Ditto.

Gul-i-shaftalú (color of nectarine flower)—crimson (carmine).—Ditto.

Gulánár (color of pomegranate flower)—scarlet color.—Ditto, tinted with yellow dye.

Náringi (orange)—deep orange.—Ditto, with harsinghár.

Shingarfi—Cinnabar red, "Shingarfi" (mineral).

Kirmizi (kermes)—Dull red.—Said to be safflower with a trace of indigo.

Suneri (color of gold)—orange.—Made with kussumba and harsinghár in excess.

Champai (color of champa flower, *Michelia*)—orange (lighter) —Harsinghár.

Sharbati (color of wine)—salmon colored—Harsinghár and kussumba.

Basanti zarfishán—yellow, sprinkled with crimson.—Turmeric, with kussumba sprinkling.

Halka káfuri—almost white.—Harsinghár.

Kafurí (color of amber)—lemon yellow.—Ditto.

Basanti—bright yellow.—Turmeric.

Sewati—toad color.—Turmeric and indigo.

Múngyá—the same, slightly bluer tinge.—Turmeric and naspál.

Salgi—dark green.—Indigo and turmeric.

Kupási (cotton plant color)—pleasant pale green—Green extracted from English fabrics.

Dháni—full green.—Indigo and turmeric.

Surmai (antimony color)—dark blue; near black.—Indigo.

Asmáni—sky blue.—Ditto.

Nukrei (silver color)—pale silver blue.—Indigo and lemon rind.

Lájwardi—fine purple blue—Safflower and lajward. (This is a beatiful color, but so "kutcha," that it rubs off between the fingers).

Kásní (color of chicory flower)—lilac, with preponderance of pink.—Safflower and indigo.

Fálsáí (*Grewia* flower color)—reddish lilac.—Ditto, different proportions.

Sosan (lily iris color)—puce.—Ditto.

Kokai—dull mauve or pale lilac.—Ditto.

Siyah bará—a fine black.—Pomegranate rind, kahi, &c.

Kishmishi (color of raisins)—warm brown.—Khatta and pomegranate rind, &c.

Sandli—(sandal wood color) paler ditto.—Ditto.

Máshi—deep brown—Alum, turmeric and pomegranate rind.

Dúdhiya kháki—dove color, pale.—Kíkar seeds and galls, &c.

Kháki—gray drab.—Pili mitti, naspál and galls.

A'gari—red brown.—Naspál, katth and galls.

Kákarneri—chocolate brown.—Ditto.

1711.—[4548]. Frame, exhibiting specimens of 60 dyes, and 12 printed calicoes. Prepared by Nur Muhammad of Lahore.

The colors are those, the preparation of which was described at the commencement of this chapter. NUR MUHAMMAD is a very aged man, over 90 years, and has great repute among the natives of this city as the cleverest of dyers.

1712.—[4593]. Specimens of dyed cotton thread. GUJRAT JAIL.

Scarlet, purple, "gulabbási" lilac-red (color of *Mirabilis jalapa* flowers), "piyázi," "surmai," asmaní," "kásní," "khákí," "sabza" "marúli (shade of green), "sabza pistai" (color of pistacio nut, pale green), "zard" (yellow).

1713.—[4623-33]. Gugaira. Pak Pattan. LOCAL COMMITTEE.

Cloth—red.—Dyed with safflower.
Ditto—deep pink.—Ditto.
Ditto—pale pink.—Ditto.
Ditto—orange.—Dyed with safflower and *Nyctyanthes*.
Ditto—pale orange.—Ditto.
Ditto—red.—Ditto.
Ditto—purple.—Dyed with indigo and safflower.
Ditto—purple.—Ditto.
Ditto—deep purple.—Ditto.
Ditto—purple.—Ditto.
Ditto—green.—Dyed with indigo and turmeric.
Ditto—yellow.—Dyed with turmeric.

1714.—[10408]. A series of dyes, simple and compound, capable of being produced by shades and combinations of indigo, safflower and turmeric. Muzaffargarh. LOCAL EXHIBITION COMMITTEE.

PRINTED FABRICS AND BLOCKS.

1715.—[4442]. Cloths printed with silver and gold leaf. MUNICIPAL COMMITTEE, Delhi.

The pattern is first stamped on the cloth by a block charged with a gummy mixture, after this the tin, silver, or gold leaf is laid on, adhering wherever there is gum. When the whole is dry, the superfluous leaf is brushed off. There are some very pleasing specimens of this work among the articles of clothing from Kangra and Ambálah, but the process is rude, and the patterns, though often pretentious enough, do not come clear and well defined.

These stamped clothes are much worn on gala days by the hill people of Kangra, &c.

1716.—[10047]. Series to illustrate block printing, in madder of two shades, and black. Muzaffargarh. LOCAL COMMITTEE.

The blocks, being of hard blackish wood, the cutting of which is an express trade, accompany the samples.

The cloth to be printed is first steeped in a solution of tamarisk galls (máin). The 1st block, charged with a mixture of "kahi" (sulphate of iron), is stamped, and thus producing a pattern in black lines by the chemical effect of iron on the tannin in the galls. When this is dry the parts intended to be of a very deep red, are stamped in by a 2nd block, charged with a mixture of alum, and finely ground soapstone or ochre. When this mixture has dried on, the whole is boiled in the madder vat. The block pattern remains unaltered, but wherever the ochre and alum paste has been, the madder settles with a deep red; and wherever the plain cloth, merely stained with the galls has left, the madder issues a pale tint. The result of the whole is very pleasing at a distance; and cloths printed in this way are very cheap, but the process is rude in the extreme.

Some of the printed floor cloths and bed covers of Múltán, are very beautiful; they exhibit all that fertility of pattern-design, which natives are capable of. The fabrics will not of course wash—but verditer blue, black, turmeric, yellow, "kussumba" red, madder, &c., enter into the combinations of colored patterns employed.

A set of blocks and apparatus for calico printing were sent from Amritsar (10357).

A set of blocks for calico printing, used by the Thuggee School of Industry in preparing tent linings was sent (10383).

A set of very elaborate blocks, as a kind of shawl pattern, were sent by the Hushyarpúr Committee.

All these blocks are cut from a dark hard wood, the pattern standing out in high relief, the indentations being cut very deep.

REPORT ON SUBSTANCES USED IN DYEING.

CLASS IV. SUB-CLASS (C). SUBSTANCES USED FOR DYEING, INCLUDING CLOTHS DYED TO ILLUSTRATE THE PROCESS,—PRINTED FABRICS AND BLOCKS FOR PRINTING—ALSO ARTISTS' OR OTHER TRADES' COLORS, AND MORDANTS.

JURY.

DR. BROWN,
MR. F. E. GORDON,
MR. R. H. DAVIES,
MR. R. E. EGERTON,
MUNSHI HARSUKH RAI,
SARDAR JASSA SINGH.

REPORTER—MR. B. POWELL.

IN every nation the art of dyeing, however rudely and unscientifically practised, is to some extent known, provided the nation has reached a stage of advancement sufficient to produce something in the nature of a fabric, to receive the dyers color; and even before this stage, while as yet the people are mere savages, they readily discover those curious color-yielding plants which exist more or less in every climate, and of which the "woad" used by the ancient Britains to stain their bodies, furnishes a familiar example.

Perhaps no art has ever received more rapid or successful development than that of dyeing. While botanical science has worked in pointing out new plants yielding coloring principles, chemistry has been no less active in furnishing methods of fixing and brightening these coloring matters, in teaching us their affinities and attractions, and in educing from mineral sources fresh dyes. Witness, for instance, the recent discovery of "rosaline," from tar—yielding all those beautiful shades, known by the names of magenta, opaline, &c.

Chemistry is alluded to, because it is precisely in that branch of the art of dyeing wherein chemical knowledge comes into practice, that the dyeing of this country fails so conspicuously.

It was impossible to look at the large frames containing series of dyed cloths from Lahore and Muzaffargarh (4548 and 10408), and the book of dyed cloths from Delhi (4442), without noticing the large variety of tints that can be produced from the simple substances for the most part employed by native dyers; and yet, the number of these that are not fast is very large—some of them will not stand washing,—others will not stand exposure to light. For instance, the beautiful "kussumba" (*Carthamus tinctorius*) yields 6 or 7 distinct shades of red—the palest pink, or *piyázi*, *gulábi* (pink), *gulábi surkh* (rose color), *kulfi* or *gul-i-shaftalú* (deep red). Again, in combination with *harsinghár* flowers (*Nyctanthes arbortristis*), it yields *soneri*, or golden orange; *nárangi*, deep orange; and *sharbati*, salmon color; and with turmeric (*haldi*, *zard chob*), it gives a splendid scarlet, *gul-i-ánár*, and other tints; again, if combined with indigo, Prussian blue, &c., a series of beautiful purples,

known as *lájwardi, úda, náfarmáni, sosani, kásni* (a delicate mauve), *fálsai, kokai,* and the deep purple, *baingni.* Now, all these tints are more or less beautiful, but scarcely one of them will stand washing. There is a great want of that series of substances known as mordants. The use of the salts of tin and lead is entirely unknown to native dyers. There is no known mordant that fixes safflower, hence all the scarlet dyes are not permanent; and the Jury have not been able to award the Prize for a permanent scarlet dye for cotton, offered by LIEUT. LANCE. The same is true of the Prize offered by LIEUT.-COLONEL S. BROWNE, for the best "khakí," or ash-gray dye.

Under the head of Dyes the report embraces the consideration of—(1), materials for dyeing, with incidental notice of *colors* observed in the fabrics exhibited in other classes; (2), calico printing, in colors and metallic leaf; (3), artists' colors, including coloring substances applied to turned wood ware, and colors employed in "mínú kárí," or enamelled work.

The collection includes from No. 4437 to No. 4687. But, in this series, a very large number are merely the same substances exhibited from different districts. In some instances, such as indigo, the repetition is highly interesting and valuable as a means of comparison; in others, the difference is almost inappreciable. The list of *kinds* of articles exhibited is as follows:—

Indigo.—There are 14 specimens. One each from Delhi, Gurgaon, Hissar, Ambálah, Ludhiana, Jálandhar, Hushyarpúr, Kapúrthalla, Bahawalpúr, Pattiala, Muzaffargarh, Dera Ghází Khán, and Dera Ismaíl Khán and Jhínd.

There are exhibited from Lahore, though no indigenous indigo, a sample of ordinary dyer's Múltán indigo; another sample of indigo from Múltán, and a specimen of indigo from MESSRS. SKINNER'S factory at Hansi, sent by them to the Central Museum some time ago.

Amritsar exhibits a sample of Múltán indigo, and also of a substance called "níl safá," which is not indigo, but Prussian blue (ferro-cyanide of iron), and probably obtained from Europe.

The factory of MESSRS. SKINNER AND CO., exhibits a fine sample of indigo; as does also the PUNJAB INDIGO COMPANY, at Múltán.

From Sealkot there are two samples of indigo, one grown by HAKIM SINGH of Daska, another by GANDA MAL of Samryál.

Madders.—Samples exhibited by Jálandhar, Lahaul, Amritsar (not the produce of the district) and Lahore (the produce of Afghánistán), Dera Ismaíl Khán, Peshawur (imported from Kábul), Kashmír (imported from Múltán).

Safflower.—Nearly every district shows a sample in its pounded or unpounded state, viz., Delhi, Gurgaon, Rohtak, Ambálah, Ludhiana, Simla (Bhajji), Jálandhar, Hushyarpúr, Kangra, Amritsar (imported), Lahore (imported, 3 samples), Gujranwalla, Gujrát, Jhilam, Gugaira, Jhung, Muzaffargarh, Dera Ismaíl Khán, Dera Ghází Khán, Bunnoo, Peshawur, (from Kábul), Kapúrthalla, Jhínd, Nábha and Pattiala.

Harsinghár flowers (*Nyctanthes arbortristis*).—Exhibited by Delhi, Gurgaon, Ambálah, Gugaira and Pattiala.

Dhák flowers, "gulí-kesú" (*Butea frondosa*).—Exhibited by Rohtak, Ambálah, Jálandhar, Kangra, Gujrát, Jhilam, Shahpúr, Gugaira, Dera Ghází Khán, Kapúrthalla, Kashmír and Hushyarpúr.

Mehndi or henna (*Lawsonia inermis*).—Ambálah, Lahore, Gujranwalla and Shahpúr.

Sappan wood "bakam" (*Cæsalpinia sappan*).—Exhibited by Gurgaon, Jálandhar and Lahore.

Toon flowers (*Cedrela toona*).—Exhibited by Ambálah, Kangra, Kashmír and Pattiala.

Turmeric.—Simla (Bhajji, Baghat and Bagal), Jálandhar, Hushyarpúr, Kangra, Amritsar, Lahore, Dera Ismaíl Khán and Bunnoo.

A root called *ál* (*Morinda tinctoria*) is exhibited from Gurgaon (4450).

Lac dye from Delhi; *cochineal* from Peshawur and Lahore; a substance called *Berberine*, from Simla.

Ekl bír from Jálandhar, Kashmír and Kangra.

Kamela is exhibited by Ludhiana and Kangra.

Akasbel (*Cuscuta reflexa*) and *harmal* (*Perganum harmala*), are among the dyes of the Jhilam district.

Lahaul exhibits a kind of madder, or red dye, "kúáme;" and Spiti a wood, called "púrlú," and one called "nayál-i."

Peshawur exhibits "flowers of asbarg" (*Delphinum sp*——?) from Kábul; as also Amritsar and Lahore.

Kashmír sends a dye called "darengri;" also "rál," a resin used in dyeing "pashm."

Kashmír and Dera Ismaíl Khán exhibit *saffron.*

Amritsar, besides the above-named substances, sends samples of substances called "akbíj," "boz gand" (the galls of *Pistacia*), and "harkadí."

Ludhiana sends a red dye, "kirm," a crimson extract, probably of *lakh.*

These form the principal coloring substances. There are also other substances of the nature of mordants, and substances used for intensifying the tints, such are the following:—

Tamarisk galls, "máiñ" (galls of *Tamarix furas* or *T. indica*).—These are exhibited from Gurgaon, Jálandhar, Shahpúr, Gugaira, Jhang, Muzaffargarh, and Dera Ghází Khán.

Rind of pomegranate.—Exhibited from Gurgaon, Rohtak, Jálandhar, Kangra, Jhilam Shahpúr, Gugaira, Muzaffargarh and Dera Ghází Khán.

Dried mango parings.—Are sent from Rohtak, Jálandhar, Kangra.

Kishta, dried unripe apricot (*Armeniaca vulgaris*).—Exhibited from Jálandhar, Lahore and Amritsar.

Limes and *lime-juice*, also the *juice of the galgal* (*Citrus galgala*), appear in the collection of Rohtak and Kangra.

Jálandhar exhibits *bahera* (*Beleric myrobalan*), and *balelah súják* (*Terminalia citrina*).

Kangra exhibits "dhoñ leaves," "aṁwlá leaves" (*T. emblica*), and "aṁwlá rind."

Kashmír shows "máju," the fruit of the *Cupressus.* Substances used in the process of dyeing soap, soap-nuts and "ushna," are exhibited from Lahore, Jálandhar and Kashmír.

The iron mordants, "kahí safed" (proto-sulphate of iron, crude) "kahí sabz" and "kahí siyah," also containing iron, are exhibited from Lahore, Amritsar and Kashmír.

Alum and other substances, as well as one or two mineral dyes are noticed in the Mineral Department, and receive notice there.

There is a series of artists' colors exhibited from Lahore; also from Amritsar.

A series of colors prepared for the wood turner, from the same places;

And a few colored enamel sticks, for the "míná kárí," exhibited in Lahore.

Of samples of dyed fabrics, Lahore exhibits a frame of 72 dyed and printed samples; Amritsar, Kashmír and Lahore have series of dyed silk (unspun). Gujrát exhibits a series of hanks of cotton dyed, with samples of the dyed fabric attached; as does also Gugaira.

Muzaffargarh shows a series of samples illustrative of the process of printing in madder and black; and also a series of simple and compound dyes, produced from turmeric, indigo

and safflower; Múltán exhibits several beautiful printed fabrics; and Lahore, Delhi and Maler Kotla, &c., show specimens of fabrics printed with silver and gold leaf.

It remains now to add the remarks of the Jurors on the articles included under the heads just mentioned.

I. DYES.

Of these, the most valuable and important is indigo. It is peculiarly Indian in its origin, and began to be exported almost as soon as the Cape passage to Europe become known and followed.

It was known to the ancients as a product of the country. "*Indicum*," says PLINY, "comes from India, and is obtained from a slime adhering to reeds: it is black when rubbed, but a fine mixture of purple and blue when dissolved." He adds, "that the genuine *Indicum* may be known by the purple vapour it emits on being heated," and that it "emits a smell like the sea, whence some have supposed it to be obtained from rocks."

The history of the commerce of this substance would be eminently interesting, but it is not possible to enter on the subject within the bounds of a report; suffice it to say, that on its first introduction into Europe, it was almost driven out by the bitter intolerance of persons whose object was to prevent the old fashioned *woad* (then in use as much as indigo is now) from being driven out before it. In 1557, at Frankfort, it was denounced by the Germanic diet as the "Devil's dye," and its use forbidden: the prohibition was repeated in 1603; and as late as 1654, by Imperial Edict at Ratisbon, the proscription was enforced. In England an act was made in Elizabeth's time, authorizing the seizure and destruction of the offensive substance, as well as the detention of persons possessing it. The act continued in force till the reign of Charles II.: and "Brazil wood" shared the odium with it.

Notwithstanding all this opposition, the dye has become an article of universal importance, its peculiar chemical properties rendering it suitable. It can be applied as a dye in cold vats, and is one of the most permanent dyes known, and that without the use of any mordant or fixer.

Indigo is known to chemists under two forms—white indigo (indigogene) and blue indigo—the latter being only an oxidized state of the former. The blue color is entirely due to the oxygen, or at least comes to the substance as it gets access to the oxygen of the air; this is observable in the vats. When the fermented liquor or infusion of the plant first ferments with the appearance of whitish gray bubbles, afterwards these become blue, and finally a deep metallic lustred purple-red. Dyed cotton, when just taken out of the dyeing vat, appears green, but rapidly assumes its deep blue tone from contact with the air.

Blue indigo is perfectly insoluble in water, but it is found that it is so only as long as it retains its excess atom of oxygen. If it can be induced to part with that, the remaining indigogene is soluble in an excess of sulphate of lime, or other alkali. Hence, for cotton dyeing, the vat is prepared by grinding up a quantity of indigo with water to the consistency of cream, and then mixing it with copperas, and an excess of lime or alkaline water; the oxygen of the indigo then combines with the protoxide of iron in copperas to form oxide, and then the deoxidized indigo readily combines with the lime water, forming a yellowish green liquid, into which the fabric to be dyed is plunged; and then, on being taken out and exposed to the air, the oxygen returns to the solution with which the fabric has been saturated, and the deep blue is restored and becomes permanent, without the use of any mordants. The dye applied in this manner is used cold. According to the plan adopted by native dyers, "chunám," "sajji" (crude potash) and "gurh" (molasses), form the solvent and

deoxidizing agents; otherwise, the process is identical; they do not use copperas, though they have it in plenty, in the form of "hira kasis" or "kahi safed." Wool and silk are not dyed in this way, but in another manner, taking advantage of another property of indigo. Pure indigo is soluble in sulphuric acid, but the solution is thick and black. This has been called *cæruleo-sulphuric acid, sulphindylic acid*, &c. ("murabba" in Urdú), because it has the nature of both the indigo and the acid, neither undergoing the slightest change in itself. A sample of this sulphindylic acid is exhibited from Lahore, by a manufacturer, BASHI (892), and from Jálandhar (4486), where it is incorrectly called "sulphate of indigo solution." The substance is not a sulphate of indigo, that would imply a chemical combination between the acid and the dye, and the formation of a new substance; but it is not so. The acid and indigo combine, but neither is changed. This solution is capable however of destruction by an excess of caustic alkali, and turns by it to a yellow color, from which nothing will restore it.

This sulphindylic acid is principally employed in dyeing wool and silk, and the excess acid is removed by washing in alkali.

Chemically pure indigo is of specific gravity 1·50, and possesses neither taste nor smell; it is a substance "indifferent," having neither acid nor basic properties. Good indigo is known by its fine purple blue color, and by its fracture, which, when rubbed with a hard smooth substance, exhibits a coppery red lustre.

No remarks need here be added on the manufacture of indigo: the ordinary processes of fermentation of drawing off the liquor, of beating, and of collecting the "fecula," or precipitate of indigo from the liquor and pressing it, are universally well-known, and are followed with but trifling variations in different provinces and different manufactories.

The main points appear to be, the watching the soaking plants, so as to be able to tap off the infused liquor exactly at the right point of fermentation; and next, to beat the liquor in the second vat, exactly long enough. No doubt in these points the native manufacturers in this province are as yet eminently deficient. Knowledge of these things can only be acquired by careful observation and long experience. Another point is, that the "fecula" is much improved after being collected, by being boiled in coppers, and then pressed into its boxes.

Indigo manufactured by simply collecting the fecula, and dropping it down in cakes to harden in the sun, is termed "*gaud indigo;*" to this class of indigo belong all the specimens exhibited, with the exception of the sample sent by MESSRS. SKINNER and that of their make exhibited by the Lahore Museum; and also that of the PUNJAB INDIGO COMPANY, at Múltán.

There can be no doubt that the samples of indigo from the Hansi factory of MESSRS. SKINNER & Co., are the best—their indigo is better got up than any other; while its close grain and beautiful color, places it beyond other competitors in the Exhibition. Hansi, politically, is within the Punjab and provinces for which the Exhibition is intended. The Jury, therefore, award to MESSRS. SKINNER & Co., the Prize for the best indigo in the Punjab, commuting the money prize to a Silver Medal and Certificate of Merit.

Next comes the PUNJAB INDIGO COMPANY. The indigo of this Company deserves high commendation—that it is not equal to MESSRS. SKINNER's is saying no more than would be expected, from the time the Company has been in existence, and the great difficulties it has to contend with. The indigo exhibited is fairly got up, and of good color; there can be no doubt that succeeding years will see the growth of this Company, both in quantity and quality of its products. The Jury have awarded to the Company a Silver Medal.

Next to these samples come the samples of the Punjab districts. They are all of them "gaud" indigo; and some of that hard black, or pale blue tone of color, which indicates extreme badness of preparation. But amongst the samples, there are some indicating a decided advancement in the production of the dye. The color in one or two of these samples is good, and only shows what might be done if the growers of indigo in these districts would be bold enough to make an outlay for the necessary machinery of good vats, boilers, and presses. It would not require much philosophy in them to perceive that the present outlay of some hundreds of rupees would be amply repaid, if the same indigo, which they now sell at from rupees 50 to 80 per maund, could be made, by efficient preparation and "getting up," to sell at from rupees 150 to 250 per maund! It is not intended to be supposed, that building good vats and setting up coppers and screw-presses is synonymous with the out-turn of indigo like that of MESSRS. SKINNER; but there can be little doubt that indigo like that of Dera Ismaíl Khán and the Sealkot samples, would, if better prepared, *at once* command a *higher* price; and eventually, if the growers only persevered in care and observation, would attain the full value above alluded to.

Anxious, therefore, to encourage a move in the right direction, quite as much as to reward positive attained excellence, the Jury award a Certificate of Merit to Dera Ismaíl Khán, for "gaud" indigo of good color; and also mention with approbation the indigo grown by GANDA MAL of Samryál, and by HAKIM SING of Daska, in the Sealkot district. Especial improvement might be made in collecting, drying and pressing the fecula in these samples.

At present Múltán is the place where the greater quantity of indigo used by the native dyers is brought;* but indigo is extensively grown in the Dera Ghází Khán district. It is hardly grown at all as a standard crop in other districts. This is much to be regretted, as the soil and climate of many districts appears well suited to the cultivation; and with the experiences of Bengal ready to hand, we have nothing to fear on the score of those cultivation difficulties, which in other places threatened to bring the crop into disrepute.

Besides, the samples of indigo just described, there are several samples of "kulaf," or "vasma" (pounded dried leaves of indigo plant), used principally as a hair dye, after the previous application of "henna" (*Lawsonia inermis*). The powdered leaf of *Indigofera anil* is used in the cure of hepatitis.

Indigo is said to be produced from several species of *Tephrosia*, *Nerium* and *Wrightea*, and even from the *Cicer arietinum*, or gram plant. From some of these species indigo is manufactured in China, as described by MR. FORTUNE. The species ordinarily cultivated is the *Indigofera indica*, of which there are some varieties, known as *I. tinctoria*, *I. pseudo-tinctoria*, *I. glauca*, *I. disperma*, &c.

Indigo sublimes at a temperature of about 400° (Fahr.), leaving behind it the residue of carbonaceous and earthy matter. Several samples of the Exhibition indigos have been taken 10 grains of each, and the indigo sublimed; when the residue was weighed the results were as follows:—

* The Settlement Report in 1859 says, that 48,000 beegahs were cultivated with indigo. It is now probably much increased. About 40,000 maunds of indigo are yearly produced, and not a little of this finds its way over the frontier to Kábul, &c., in exchange for madder and other commodities. The establishment of the Múltán Indigo Company will no doubt tend largely to increase the production of indigo, as well as to extend the trade. Native dyers prefer always the Múltání indigo, but also like much an indigo brought up from the Delhi direction, from Khúrjáh, a place to the south of Bulundshahr: they call all indigo prepared under European factors, and on the European methods, "Wilayiti nil," a name which is sometimes incorrectly given to the Prussian blue, which is imported in lumps, and is not unlike the fine pieces of indigo.

Of 10 grains,

Messrs. Skinner (Hansi), residue weighs,	6	grains, very nearly.
Punjab Indigo Company,	6½	„ „
Dera Ismaíl Khán (gaud),	6½	„
Sealkot (Samryál),	6¾	„
Dera Ghází Khán,	6	„
Múltán district,	6½	„
Muzaffargarh,	7½	„ very nearly.
Ambálah,	6½	„
Gurgaon,	7	„
Hushyarpúr,	6¾	„
Jhínd,	6½	„
Bahawalpúr,	8	„

The residue of Messrs. Skinner's, and other good indigo, is of a porous spongy carbonaceous substance, large in bulk but light in weight, containing but little earthy residue; that of the inferior samples, is in powder and heavy, indicating earthy matter and solid impurities; the inferior indigos, particularly the pale colored ones, such as Bahawalpúr, sublime along with the pure indigo a strong smelling smoke of reduced vegetable matters. The difference in purity is highly appreciable; if, for instance, calculation be made, on these data, it appears that the Dera Ismaíl Khán "gaud" indigo, contains for every 10 grains, ½ a grain more earthy and other matters, than the Hansi indigo; thus in every maund has something like 4 lbs. more impurities.

The Gurgaon, Hushyarpúr and Ambálah samples, are blackish, hard, coarse, and evince great inferiority of manufacture. The Bahawalpúr sample has a pale bluish color, and appears to be defective in the primary fermenting and beating processes, or to be a bad style of plant. The other samples might be really good indigo if prepared, dried, and got up better. Indigo has been of late years cultivated in Jammú, and the best is grown at Katúa, near Madhopúr; it sells at Rs. 105 per maund. A sample sent to the Exhibition was not so good.

Indigo is of some use in medicine, being said to be effectual in cleansing foul ulcers. The juice of the young shoots is mixed with honey for children suffering from aphthæ in the mouth.

The next dye on the list, and second only in importance to indigo, is madder (*Rubia cordifolia* or *Rubia munjista*). It is exhibited from two or three districts, but only because it is in use there; such is the case with the samples from Lahore, Amritsar and Jálandhar, which are all probably the produce of Kábul or Afghánistán. A sample from Peshawur is marked as coming from Kábul; while the Kashmír specimen is marked as not produced in Kashmír, but is brought in quantities from Múltán. One very interesting sample is exhibited by the Rev. Mr. Jaeschke, from Lahaul, it is of the species *R. cordifolia*, and is grown at Lahaul; though perhaps not equal to the Kábul madder, it is of good quality and color. Madder appears to be abundant in the valleys all along the Himálayan range—it is found at Dharmsala; and Dr. Cleghorn writes, that he gathered it in the Chandrabhaga valley. The root is procurable in the bazars of Simla and Chamba, but there is little demand. Among the woven fabrics exhibited by the hill districts, there is but little evidence of any dyeing process at all, but here and there instances of madder dyed articles appear. The borders of some of the Simla and Kangra district blankets are woven in with madder dyed threads. The principal place of production appears to be in the Afghán territory, in the Province of Kábul, and the districts of Ghazní and Kandahár.

Mr. Davies, in his Report on the Trade of the Frontier, mentions two kinds of mad-

der—one called "rodung kuhree," grown at Kandahár, which is superior; and the other kind, "rodung phurreah." The plant is stated to require three years to come to maturity. The value of madder brought through the Biluch and Afghán mountains, is stated to be £12,228. It is to some extent remarkable that the Kashmír sample should not have been produced *in situ*, for there is every reason to suppose that madder might be cultivated in Kashmír with great success.

Múltán is a great emporium for madder. The Kábul merchants come thither direct from Dera Ismaíl Khán, *vid* Leia, and exchange their madder for cotton and indigo. A sample of madder is exhibited from Dera Ismaíl Khán also; but it does not appear whether it was produced there or whether it was only brought from Kábul, as above mentioned.

The subject of the growth of madder in the Punjab has been brought before the Agri-Horticultural Society, and a quantity of French seed was actually raised by Mr. Cope, and samples of the root forwarded to England.

The native dyers judge of the excellency of madder by breaking a root across. The finest specimens are of middle size, neither very thick nor yet wiry; they break short off, exhibiting a surface of a beautiful fresh creamy yellow; the inferior specimens having a dingy reddish tinge.

In Europe madder is grown in several Provinces of France, but the best is the Dutch from Zealand. It flourishes best in a light soft soil, but will also grow in a stiff clayey one. A fine variety is imported from the Levant. The red coloring matter of the root is soluble in alcohol, and yields various tinted precipitates, with the fixed alkalis, sulphuric acid and sulphate of potash; and various shades are obtained by precipitation with alum, nitre, chalk, sugar of lead, and chloride of tin.

The process of dyeing with madder as practised by native dyers is simple: the dye color is deepened afterwards when required by alum. The fabrics to be dyed are first steeped in a decoction of "máíń," the galls of the tamarisk, and then submitted to the madder solution, hot. It is fixed by alum as a mordant, the galls seem to impart to the cloth a facility for taking the color. The color thus obtained is a deep full red, it is quite permanent, but is not brilliant, cannot by any stretch be called scarlet; hence the Jury have not thought right to award to specimens of this dye, the prize offered for a scarlet dye; nor have they awarded any for the root, as none, with the exception of the Lahaul sample, is indigenous. It is most remarkable, however, that the beautiful and permanent dye, known as "Turkey red," and which does deserve the name of scarlet, is a dye of Indian origin. The process was learnt in India and carried to Eastern Europe, whence it found its way into Greece, and was introduced into France and England in the middle or end of last century. The process consists in preparing the fabrics to be dyed, by previously saturating and working them up with a mucilage, composed of olive oil, with a proportion of alkaline lye, not sufficient to saponize the liquid, and with cow-dung or sheeps'-dung. These substances, are intimately combined, and the fabric is made to imbibe into its pores this substance. This process evidently reduces the fibre of the piece to a peculiar condition, fitting it to receive the dye of madder. The cotton, after having been treated with the oily mixture, is steeped first in gall solution, and then in an alum solution, after which it is boiled in madder, with which a portion of animal blood is mixed, and the process is finished by washing the dyed cotton in a boiling solution of white soap. Notwithstanding, as before remarked, the fact that this process originated in India, it does not now appear to be either remembered, or practised, at all events, in Hindústán and Upper India. It is probable that the "chaya" root (*Oldenlandia umbellata*), a sample of which has been forwarded from Madras for comparison,

was the root employed in dyeing according to the process just described. The whole of the red cloth, so common in every part of India, and called "sálú," is imported from Glasgow and Mancester, where the process is carried on, and the imports of this kind of cotton fabric must be very extensive. It is much to be regretted, that having the dye-stuff on the spot, such a profitable art should have been lost; and it yet remains for individual intelligence and enterprise to re-establish it, the attempt to do so could hardly fail to be successful and profitable, as it does not appear that any complicated machinery is at all essential. The process, it may be mentioned, was started in Glasgow in 1790, and the Commissioners of Trade purchased the secret, which was only to be divulged after a given period, now long elapsed. Madder dyeing in Europe is practised with much happier results as to color, which is probably owing in part to the superiority of the Dutch madder (*Rubia tinctoria*), but mainly, no doubt, to the very superior process of dyeing employed. This dye is capable of combination with indigo, and other substances, to form compound tints of various shades and degrees. In Europe a very beautiful permanent series of artists' colors, varying from the palest pink to carmine is produced from Dutch madder. No attempts seems to have yet been made how to produce such colors from Indian madder.

Closely allied, in a dyer's point of view, to madder, is the sample, which is the only one sent, of the "ál" root (*Morinda tinctoria*), (4450), from the Gurgaon district. This is stated to grow everywhere in India, but is certainly little, if at all, known to Punjab dyers. It is a small whitish root, yielding a red color. It appears nearly all species of *Morinda* yield red dyes.

The next dye that claimed notice was the beautiful *kussumba (Carthamus tinctorius)*, or safflower, called also bastard saffron.

The value of this substance as a dye is much lessened by the fact that it has no affinity for any mordant, and therefore cannot be made permament; the series of dyes it gives are most beautiful, consisting of lake reds of all shades, from the deep "gul-i-shaftálú" to "gulábi" and "piyázi" pinks of the palest tone; combined with turmeric it yields a beautiful scarlet; and with various blues—indigo, Prussian, and ultramarine—gives lilac and purple tints of great beauty; none, however, being permanent. The fabric to be dyed with safflower is first steeped in the acid solution of "kishta." The flower yields two colors—first a yellow and then the red—the flower is reduced to a powder, and then treated with water till the yellow color ceases to appear, the residue is then pressed into cakes, and yields the red dye. In Europe a fine red powder is precipitated from the infusion of the red dye, and collected as a rouge. The number of samples of the dye, both pounded and unpounded, is very great; it appears to grow freely in almost any district thoughout the province, though it is scarcely a generally grown crop in any of them, except perhaps in Hushyarpúr and in the hill districts. A sample in the Lahore Museum was produced in the Gurdaspúr district. Native dyers reckon the hill safflower the best; and good samples may be known by the clear brilliant color of the flowers. A second quality is known as Hushyarpúrí, which is not quite so good. "Gujrátí kussumba" is also a kind mentioned by the Lahore dyers—examples of each of these kinds appear in the Lahore collection. Of samples exhibited, the best is that from the Kangra valley (4496), and the Jury award to it a Prize of two Shares.

The other hill safflowers, from the Simla States, were good. Of plain districts, the Gugaira sample deserves mention (4619). It was valued at about 1½ seers to the rupee; the Hushyarpúr and Jálandhar samples at about 2½ seers; and the Ambálah at 3 seers.

Of cloths dyed with kussumba, a fine series was exhibited from Lahore, showing all the

shades. An interesting series appears also in the Muzaffargarh collection, and there are samples from Gugaira. There is a successful sample of thread dyed scarlet with turmeric and "kussumba" in the Gujrát jail: it is only a pity that so beautiful a tint should not be permanent.

The only other red dye in the collection, indigenous to the Punjab, is the *lac* dye—a small quantity of which was exhibited from Delhi. The growth of the gum lac, is noticed under the Class of Gums and Resins, and therefore needs no further mention here. The crude lac is gathered and the color is extracted by solution, it is then concentrated and clarified: it yields a fine color, much used to dye silk.

A sample of cochineal is exhibited from Peshawur; it had been obtained from Bukhárá, to which place it was imported from Bombay. It yields the most beautiful series of pink and crimson tones for silk dyes, and is capable of combination with pale blues, till it gives tones of a beauty almost equal to the magenta and rosanaline dyes of Europe. It is no doubt a regular article of import trade for Bukhárá, and the Bukhárá silks (a series of which are exhibited in the Lahore collection) as are dyed with it. It is imported also to Kashmír, and may be found in most places where silk dyeing and weaving is carried on.

Among the pashmina fabrics of Kashmír, there was one plain shawl, of the most beautiful magenta shade, with a slight tinge of blue; this might have been dyed with an European rosanaline, but it was more probably a native cochineal dye; and if so, vies wonderfully with a fine sample of a dyed silk piece exhibited from Amritsar, by CHAMBA MAL (Series No. 9620-23), which was actually dyed with rosanaline.

One or two samples of *sappan* wood occur, which yields good, but not permanent, tints. The wood is called "bakam," or "vagam," or "patang" (*Cæsalpinia sappan*). It is not produced in the Punjab at all, and is imported partly from Southern India and partly from Bombay. It is a congener with the Brazil, Brazilletto and Nicaragua woods of the dyers.

Among the articles sent up from Madras, a concrete red dye, from a species of prickly pear, and a bottle of red ink of a beautiful color, demand notice, as they call to mind the fact, that a species was once very common in the Jálandhar and Hushyarpúr districts; in fact it became quite a nuisance: it was destroyed, however, by myriads of the wild species of coccus, which yields an inferior cochineal.

A reddish color is yielded by the "henna" or "mehndí" (*Lawsonia inermis*), exhibited from several districts: it is used by women to stain the tips of their fingers; and also as a hair dye. The hair is first dyed with henna, and then with indigo, to made a black, otherwise the substance is of little importance. The natives esteem most the Gujranwalla "mendhi."

There is a substance used for dyeing red in Lahaul, and called "kúámí." It is a long dark-colored root, of a species allied to the *Anchusa*, and called *Onosma echioides*. There is no sample to show the color produced.

Of yellow dyes a considerable number appear.

The flower of the *Nyctanthes arbortristis*, exhibited from several districts, yields a yellow dye of a good color.

And the *dhák flowers*, "gul-í-kesu," also are exhibited from a number of districts. They are themselves of a yellow color, and yield a yellow dye; similarly, the flowers of the tún (*Cedrela toona*).

Ekal bir, the roots of the *Datisca cannabina*, is valued as a dye. Yields a pale yellow dye, which also enters into the composition of an apple green dye. It is used principally

in dyeing wool and silks: and it is exported from Lahaul, Kúlú and Pangí. The sample exhibited was from Kangra.

Turmeric, "haldí" (*Curcuma longa*), is a root of considerable importance, both as a food, a condiment, and a dye. The native dyers readily distinguish the kinds best suited for dyeing from those that have the best edible qualifications. The turmeric from Hushyarpúr is about the best (4084), and receives a Prize of One Share. The Jálandhar sample is better as an edible sample than as a dye. Some very excellent turmeric has come from several of the Simla districts; and some samples of the root, fresh and undried. The root is medicinally considered cordial and stomachic; as a dye it is a beautiful, but not very permanent, color. The best used of eating turmeric is caled *ágrái*: the best dyeing sort *chawán*.

Asbarg is a dye not permanent, and used principally in dyeing silk: it appears to be a species of blue-flowered *Delphinum*: the Peshawur specimen is from Kábul. It is not grown in the plains.

Kamela, is a somewhat remarkable substance, being the reddish powder collected off the capsules of *Rottleria tinctoria*. In medicine it is purgative.

Last, among the yellow dyes, but not least in value, is saffron, like turmeric used as a condiment and article of food, as well as a dye. A fine sample of saffron from Kashmír, was exhibited by PUNDIT MUNPHOOL. Dera Ismail Khán exhibited a sample, though it does not appear whether the sample is the product of the district or imported from the hill districts of Afghánistán. Saffron is not cultivated in the Punjab plains at all, but is so extensively in Kashmír. The substance consists of the dried stigmas of *Crocus sativus*, and its coloring matter is very peculiar, and has been termed *Polychroite*. It is totally destroyed by the action of solar rays; and forms blue and green tints with nitric and sulphuric acid, or copperas. It is not much used as a dye. Its original habitat is not known, but in Sanscrit it was called, "kasmírajamna," suggesting Kashmír.

A few other individual samples remain to be noticed. Amritsar shows some of the little hollow galls of *Pistacia terebinthus*, called "boz gand," and a substance called "harkaddi," which did not come to the notice of the Jury. Unfortunately, the same occurred with the Kashmír sample of "direngri," which was not to be found, and therefore nothing can be said of it.

The "purlu" and "náyálu," from Spiti, are twigs of some trees abounding in tannin principle.

The "harmal" seeds (*Peganum harmala*) from Jhilam deserve notice, as the substance is beginning to attract notice in Europe. A principle called harmaline has been extracted from the seeds, used in black and brown dyeing; the plant and seeds are also used by natives as a drug and fumigatory to eject evil spirits.

The plant is found abundantly on waste and broken ground in most parts of the Punjab—though a plant limited as to the region in which it grows—large quantities of the seed might be collected, if it were found of sufficient value to export.

The above includes the whole of what is note-worthy in the dyeing substances. It remains to notice these substances which are used as *mordants*, or else as substances, which not having color in themselves, help in the formation of black and other dyes. Such are the galls of *Tamarix furas*, the "dháo" leaves of Kashmír, and the "kíkar pods (*Vachellia farnesiana*): other substances appear to *brighten* the colors, as "*kishta*," &c., and they are also included.

Alum is much used as a mordant; and "kahi siyah" and "safed," earths containing iron

in one form or another; but the use of the salts of tin, which seem of great efficacy with delicate tints, appears unknown.

Máin (or the galls of the *Tamarix furas*) are much used in dyeing. All the madder dyed cloths are first steeped in it. It is also used in dyeing black with salts of iron. There are two kinds—"máin barí" and "máin chotí—but there does not appear to be any difference really, save that the large galls picked out form the "máin barí." They are both the produce of the same tree. The number of specimens exhibited is considerable, as might be expected, from the facility with which the tamarisk grows in almost every district. It is particularly abundant in Jhang district.

The *rind of the pomegranate*, "naspál," yields a yellow color, and is highly astringent: it is much used in dyeing yellow with other substances. This is likewise produced from various districts; and although the fruit borne by pomegranate trees generally in the province are almost unfit to be eaten, the rind does well for the purpose of an astringent dye.

Dried mango slices, "ám chúr," yield an acid solution like "kishta," employed along with some dyes to brighten and fix the color.

Lemons.—Lemon juice, and the juice of the "galgal." Exhibited from Rohtak and Kangra, are useful in the process of dyeing black.

The remaining substances "májú" (fruit of *Cupressus*), "balela sujah" (*Terminalia citrina*), "bahera" (*T. belerica*), are highly astringent, and are used in dyeing black. "Bahera," particularly, in making black leather.

Similarly the "dháoṅ" leaves, *Conocarpus latifolius* of Kashmír, also the "aṅwla" leaves and rind (*Phyllanthus emblica*), abound in tannin or other astringent principles, and might almost be classed under tanning substances. The "dháoṅ leaves" yield a "kháki" dye to cloth, previously prepared with iron: the pods of the "bábul" (*Vachellia farnesiana*) are similarly employed; and a specimen of cloth thus dyed was found in the Delhi book of dye samples.

The use of mordants does not appear to be well understood by natives. The principle of their employment is, that if mere color, soluble in itself, be imparted to a fabric, it will again wash off; but a mordant is a substance which can fix the color in an insoluble form in the fibres of the stuff. The mordant need not have any attraction for the stuff, but simply while in contact with the stuff, renders the color of the dye insoluble within the fibres. Indigo and safflower have no affinity for any mordant; but indigo fixes itself without, because it is insoluble already, and is rendered soluble during the process of dyeing, the dyed cloth being exposed to the oxygen of the air. The soluble indigo it had imbibed becomes insoluble.

Much benefit would accrue to the art of dyeing in this country, by the introduction of the tin mordants, acetates of iron and lead, &c. Native dyers miss many a good color by the want of these: for instance, bichromate of potash, "kahi surkh," is to be found in any bazar, and yields a fine series of yellow and orange tones, with salts of lead as the mordant.

Of dyed cloths, besides colors which are to be noted, even though the fabric was exhibited in the manufactured department, there are a series of about 72 dyed cloths, prepared by a Lahore dyer, exhibiting a creditable series arranged in tints, and showing what a multitude of shades are producible from the comparatively few and simple materials that are employed.

A series from Muzaffargarh, Gugaira and Delhi also appear; and Gujrát sends a good series of dyed threads. Silk dyeing is illustrated with success from Lahore, Amritsar and Kash-

mír. Some tints are very beautiful, and in the case of silks, for the most part permanent. The Jury have awarded to Lahore a prize of two Shares for the series of dyed cloths.

II.

There are also to be noticed some interesting specimens of printed and stamped cloths, both in colors, and in gold and silver leaf. These are included, either the Cotton or Embroidered Departments, and are there unnoticed, as it is the printing art and not the fabric that is remarkable. There are colored cloths exhibited from Lahore, tahsil Kasúr, and from the Thuggee School of Industry: from Gugaira (6099, 6104-05, and 6114); from Múltán (6036-67-68-69); Kapúrthalla (6186); Gujranwalla (7574); Ludhiana (5784-85); the printing in silver and gold is illustrated from Delhi; from Kangra (7496); from Lahore, (of a superior quality), (8711-12); and besides this, from Peshawur. There are several articles of clothing also more or less printed in this way. A very interesting series from Muzaffargarh shows a pattern in all its stages, together with the wooden blocks used in printing. These blocks are cut from a hard dark wood, with considerable ingenuity.

The Muzaffargarh sample (1047) is of black, and two shades of red. The cloth is first steeped in galls, and then a block prepared with iron salts, struck on this produces a line or black figure. Next, the parts that are intended to be a deep red are treated with alum, made into a paste with ochre, and the whole is boiled in madder: the iron black remains, and wherever the alum has been, the madder, fixes in a deep shade, and in other places in a lighter shade. Many of the samples are, however, produced solely by the aid of blocks without boiling the whole in any dye: such are the Múltán and Kasúr specimens. The compound colors are produced by printing one block over another, blue over turmeric for green, &c., &c.

The Jury has awarded to Múltán printed cloths a Prize of two Shares, for their printed cloths (6036-37-38-39)—for their pattern, excellent coloring, and the neatness with which the prints of the blocks has been effected; and a two Share Prize is also awarded to Muzaffargarh, for the illustrative series, alluded to above. It should be remarked that these printed fabrics are not fast colored, and the European art of making *fast* cotton and muslin prints has yet to be introduced: the improvement too, in pattern, will come with improved design, knowledge and taste.

In the case of the gold and silver printing, the parts intended to receive the metallic leaf, are stamped as by a block with a thick "lera" gum (a coarse arabic or sirris gum); and then gold or silver leaf or imitation gold and silver leaf laid on, as the case may be: these kinds of fabrics are worn much in the hills on gala days.

One sample of printed cloth was very remarkable, it was an Afrídí woman's dress, from Peshawur; here pieces of the shape of leaves had actually been raised up on the fabric. This is effected by means of a composition into which gum-lac enters largely. The composition, while soft, is stamped thickly on to the fabric, in shape of leaves, &c., and left to dry, when it stands out in relief. It is finished by hand with a coating of colored paint.

III.

The last department included under "Dyes," are artists' colors, exhibited from Lahore and Amritsar. Wood turners' colors, and enamels, or colors used in the "míná kárí."

The artists' colors are some of them indigenous, some imported. They are sold in lumps, just as at home, and prepared by being ground up with a little water and gum, and spread over the shell of the river mussel.

There is no native preparation at all analogous to European cake colors, far less the moist or oil colors. Of the latter indeed, an inferior bad smelling oil color is produced, but not for artistic purposes. This is a great pity, since the manufacture of oil colors, both for artists' and for house-painting, is by no means difficult. Oils abound in the province, and might be rendered drying by boiling or the addition of carbonate of lead. The sundras or copal, yields an excellent varnish when boiled with oil; and turpentine is easily procurable. The method of preparation of water colors is what gives the heavy body color like look to all native paintings (unless they have been executed, which they often are, with European cake colors). They are unable to grind the colors with sufficient fineness to produce transparent washes of color.

These tints are several of them indigenous—such as the verditer (sub-acetate of copper), "zangár," dragon's blood (juice of *Pterocarpus draco*), ochre, light red, "gerú" and "peori" (Indian yellow), a curious substance, gathered as a sediment from the urine of cattle fed on mango leaves, and some other plants.

Several are imported and European, such as *peori Wilayati* (chromate of lead), the (emerald green of painters), and "lájward," or imitation ultramarine, a substance now very common, produced artificially, in imitation of real ultramarine (lapis lazuli); it sells for about Rs. 4 a seer. The real ultramarine, is procurable in small quantities. "Hartal," or orpiment, is commonly in use, and is said to come from Southern India.

The native color series is very defective in browns. Their indigenous brown tints are prepared at a great expense in shells (these tints are called "dar chíní," &c.), the European Cologne earth, Vandyke earth, sepia and sienna earths are quite unknown, save as imported colors. It is remarkable, however, that bone brown (the finely sifted powder of partially charred bones) is not in use, for it is easy of manufacture, and cheap: the color is a tolerable one, though not much used in Europe an account of the superiority of the earth browns, before alluded to.

Colors for the wood turner are prepared by mixing the powdered color with lac and sulphur into sticks. They are applied by pressing the color stick against the turned article while it revolves rapidly; the heat evolved by the friction being sufficient to melt the lac, and the color spreads on the wooden article, and is afterwards smoothed by the edge of a piece of bamboo used as a burnisher.

As to the enamel colors they consist of vitreous matter, colored by cobalt, and other metallic oxides capable of diffusing their coloring matter through the substance. Blue and green form almost the only tints used. This kind of enamelling is applied to silver vessels, on which a flower pattern is first cut out in relief, and the ground is then filled in with enamel: the effect is very pretty, and is well illustrated in the collection, under "Precious Metals," from Kashmír.

In thus drawing to a close the Report which, from the importance of the subject matter, as well as the number of specimens included, has necessarily been rather lengthy,—it cannot fail to strike the observer that the art of dyeing—one of the most valuable of the ornamental arts of civilized life, is almost at a stand-still. The knowledge of the art possessed by natives is wholly empirical, the recipes are handed down by one generation to another, and it is probable that 50 years ago, precisely the same dyeing was done as is now—and yet the aptitude of the dyers for their art, and the really wonderful manner in which they

produce tints of considerable beauty, with the few materials and earthen pans which form their whole stock in trade, certainly render them deserving of a better fate. It remains for European intelligence to improve the art by aid of chemical knowledge, especially in the way of showing methods of fixing the colors, and in the improvement of mordants. One of the most hopeful arts appears to be that of cotton printing. If only the printed colors could be fixed so as to stand washing, and a very small amount of taste introduced, to make neat patterns and suitable coloring, a most useful series of cotton prints and chintzes might be produced with great success. The import of these fabrics must be very large. There seems no reason why they should not be prepared here: at present printing is only done by natives on inferior cloth, but it might be done with ease on good material, when once a fixing process became practised, which rendered washing the fabric practicable. No art suggests so much the want of Vernacular Instructors or Trade Manuals as that of dyeing. A simple book on the processes of dyeing, as they are and as they might be, would be a great desideratum: the same may be said of oil paints. There is abundance of material for the production of good house paint (to say nothing of artists' oil color), and yet at present we are condemned to bare wood-work or sticky varnish. It is only to be hoped that these suggestions may be taken up by some person, possessed of intelligence and enterprize enough to try and introduce the simple, but much needed, improvements alluded to.

BADEN POWELL,

Reporter to the Jury.

CLASS IV. SUB-CLASS (D). TANNING SUBSTANCES.

The preparation of leather is carried on more or less in every district, but the best is done at Shahpúr and in Gugaira; while the red goat skins of Nurpúr (Kangra district) are famous, and are a staple article of trade.

1717.—Bark of the bábúl or kíkar *(A. arabica* and *A. vera)*.

This is the commonest tanning substance, because the tree producing it is common all over the province. The bark is highly astringent; and, besides its use as a tan, it is used medicinally. The pods of the "kíkar" are collected and sheep are fed on them; while from the seed vessel of *A. vera*, a bitter gummy extract, called "akákiá," is obtained. The bark is used in the distillation of spirits.

Specimens of the bark were sent from—

(4638) Delhi.
(4639) Rohtak.
(4653) Dera Ghází Khán.
(4695) Shahpúr.
(4700) Gugaira.
(4072) Muzaffargarh.
(4706) Pattiala.

1718.—[4416]. Acorn cusps, containing tannin and gallic acid; and

1719.—[4418]. Extract from the same. Hills near Simla. Mr. Geo. Jephson.

1720.—[4690]. Oak bark, of two varieties *(Quercus incana)*. Simla. Mr. Geo. Jephson.

A sample of oak bark (ríń) is sent from Hazárá (4705).

1721.—[4691]. Máju phal. Kangra. Local Committee.

These are called gall nuts, and might easily be mistaken for such, but are in reality the round, or rather polygonal fruit or berries of the cypress, and other allied species. Máju, however, is very often a real oak gall; this must be imported, as I am told that the hill species of oaks never have galls, and these are the only indigenous species.

1722.—[4694]. Mulla bark *(Zyzyphus nummularia)*. Jhilam.

1723.—[4696]. Post jhánd, bark of the jungle bush *(Prosopis spicigera)*. Shahpúr. Local Committee.

A sample is also sent from Gugaira (4699).

The following account of the tanning process has been received from the Local Committee at Shahpúr.

A cow hide is the most generally useful, being strong and soft. The harness sent to the Exhibition was all made of it: a good one is worth Rs. 2.

A buffalo hide is the strongest of all, but very hard. It is used for shoe-soles, &c.: worth about Rs. 4.

A camel's hide is too hard for most purposes, but is used for making "ghí dubbers:" value Rs. 1.

A bullock hide is inferior in usefulness to a cow hide.

A horse hide is scarcely any use at all, being too thin and fine.

A goat's hide is useful for parts of womens' shoes, &c.: value about 2½ annas.

The process of preparing a hide is as follows:—

The skin is soaked a day and a night in water, then taken out and scraped.

Then spread hair downwards on straw, and after rubbing the upper side with 1 chitak of "sujjee" and 1½ seers of lime, and a little water, it is tied up with the "sujjee" and lime inside.

It is then soaked for 6 days in 2 seers of lime and water, after which it is rubbed on both sides with broken-up earthenware. This is repeated at intervals till the hair is all off.

It is then taken out, well washed and scraped, and has now become "an adhauri," or untanned leather.

The tanning process then begins. Well bruised "kíkar" bark ("jhánd" is also used, but not considered so good) is soaked in water and the hide thrown in. When the tannin has left the bark, fresh bark is put in. This takes some days, after which the hide is sown up with "moonj," an aperture being left at one end, and hung up, the open end being uppermost. It is then half filled with bruised bark

and water poured in, which as it drops out is caught in a vessel and poured back into the skin: this is continued until the lower part, when pricked, shows the color of leather. The open end is then sown up, the other end opened, the skin inverted, and the process repeated with fresh bark, until the whole is tanned.

The skin is then well washed, rubbed with the hand and dried in the sun. It is then soaked in water with bruised mádar plants.

Til oil is then rubbed over it, and it is again soaked a day in water.

Then dried, sprinkled with water, rolled up, and beaten with clubs.

It is then rubbed on the flesh side with a stick, called a "weang," made from the wild caper (*Capparis aphylla*). The whole process, in the hot weather, takes about 26 days; in the cold, about 8 days longer.

Just before the skin is used, it is soaked for a day in a little water with a chitak of alum, 4 chitaks of pomegranate bark, a chitak of salt, and a chitak of "til oil." During the day it is several times well twisted.

1724.—Bark of the amaltás, Indian laburnum (*Cassia fistula* or *Cathartocarpus fistula*).

Besides the well-known properties of the fruit or seed pods, this tree yields an astringent bark, much valued for tanning purposes in those places where it can be obtained; but it is nowhere very common.

Samples were sent from—

(4608) Jhilam.

(4697) Gugaira.

1725.—[4542]. Sakí, the astringent bark of a tree (unidentified). Amritsar.

1726.—[4698]. Máíñ, tamarisk gall. Gugaira.

These are also used in tanning as well as dyeing, wherever they are plentiful. They are of two sorts, great (*bari*) and small (*choti*). They are not, however, different species, only the large sized galls are collected separately

1727.—[4703]. Bark of the chír, (*Pinus longifolia*). Thandyání hill, Hazara.

This is a remarkable specimen of pieces of bark of great lightness, but immense thickness, being formed by a series of almost cork-like layers, till the bark is nearly four inches thick.

1728.—[4704], Leaves of the bán (*Rhus cotinus*). Abbotabad, Hazára.

(Not to be confounded with "bhán," *Quercus*).

1729.—[4692-93]. Juice of the ak (*Calotropis Hamiltonii*). Lahore.

There are two samples—one, of the fresh milk-like juice; the other, a sample which has been mixed for leather-working purposes, with a quantity of salt. It has a most offensive smell.

1730.—[4117]. Kath, extract of *Acacia catechu*. Lahore.

Also a specimen of the "kath gulábí," pink colored, or 1st quality catechu (4108).

The *Acacia catechu*, is "khair" tree, is found in some of the lower hill districts of the Punjab; but the "kath," an extract to be found in the bazars, is generally imported from the N. W. Provinces and Hindústán.

A full description of the process is given in MADDEN'S "Account of the Outer Hills and Tarai of Kumaon." Journal of the Asiatic Society—June, 1848, p., 563.

"The manufacture of catechu is carried on by men, women, and children, the manufacturers being distinguished by the appellation 'khairí.' The men go forth to search for the trees which are best for the purpose, and fell them. A 'khair' tree, good for yielding catechu, is known by having an abundance of red heart wood. The trees being felled the wood is cut into chips. Long shallow furnaces, with covered convex roofs are erected under sheds. The convex covering of the furnace is pierced along the centre to admit of about twenty ordinary earth gharas being placed over the fire.

"The gharas are filled with chips and water, and boiled till the contents of the 20 pots will only fill two. The liquid infusion looks like thin port wine. This is set aside to cool, and the 'kath' or catechu, coagulates and crystallises over leaves and twigs thrown into the pot for the purpose. Each pot yields about a seer of an ashy whitish color.

"Women and children are employed to watch the boiling pots during 20 hours; this is managed by relays of people. The chips of wood after the catechu has been extracted are dried and used for fuel. Each furnace pays a tax of Rs. 4 to Government. The 'kath' manufacture is carried on until the rainy season begins.

"The best sample of catechu are clean and whitish, or pink color, but some are in dirty pieces much mixed with earth—this is inferior. A catechu is obtained by boiling down the nuts of the areca palm (*Areca catechu*) a thick liquid is obtained, which is inspissated, and forms the catechu of commerce."

I find the following notice of catechu in DRURY'S Useful Plants of India."

"It is occasionally mixed with plaster to increase its adhesion, and is also, in conjunction with certain oils, applied to beams to preserve them against the white ants. The most celebrated catechu is that obtained from Pegu, and this brings £4 or 5 a ton more than other astringent extracts. Catechu contains a greater proportion of tannin than other astringent substances, and it has been found that 1 lb. of this is equal to 7 or 8 lbs. of oak bark for tanning purposes. The manufactured article is brought down in considerable quantities from Berar and Nepaul, and thence to Calcutta, from whence it is exported to Europe. In four years ending in 1856 were exported from Madras 5,419 cwt. of catechu, valued at 34,657 rupees, chiefly to the United Kingdom, Bombay, Ceylon, France and Maldive Islands.

"Other kinds of catechu are prepared in India, the commonest of which is that from the nut of the areca palm *(Areca catechu)*.

"It is much used as a medicinal astringent substance. As a timber, the wood of the tree is less hard and durable than that of other species of *Acacia*."

REPORT ON TANNING SUBSTANCES.

CLASS IV. SUB-CLASS (D).

THE JURY CONSISTED OF THE FOLLOWING GENTLEMEN:—

MR. R. H. DAVIES,
MR. R. E. EGERTON,
MUNSHI HARSUKH RAI,
SIRDAR JASSA SINGH,
DR. BROWN (*Chemical Examiner*).

REPORTER.—MR. BADEN POWELL.

THIS class forms the last of the series of substances used in manufacture submitted to this Jury. The articles contained in the Sub-division are few and unimportant.

The process of leather dressing commonly followed is only adequate to the production of a coarse but strong leather. There is no demand among natives for anything like a fine leather. Their shoes, if common, are made of thick bullock's leather of its natural brown color; if fine shoes are required, there is no resort required to kid, patent polished leather, &c., the demand for which, has in Europe improved the processes of leather dressing; but cloth and gold embroidery take their place.

So with native saddlery and harness, cloth and gold thread confer the costliness and quality of the work, where in Europe we expect first-rate leather and beautiful finish. Almost the only demands for leather among natives, are for a rude and coarse kind: the shoes of the poorer clases, the water bags of the bheestie, parts of harness, and leather water vessels, are almost the only objects to which leather is applied. The hides prepared by the ordinary process are strong enough for these purposes, and there is no attempt to improve and to progress towards the processes of varnishing, enamelling and polishing.

The most pretentious forms of leather are the red goat skins of the Kangra district, used for bookbinding, and some of the leathers at Peshawur, where a good black leather is made and some green colored leather also.

The materials for these simple processes are consequently few. In the Plain districts, the *Acacia* bark comes most readily to hand, and being quite suitable is used: the bark of the "jhand," in wild jungly districts, is also astringent, and therefore used. In the Hills and sub-montane districts, there is slightly more variety. Species of *Rhus* and *Conocarpus*, with astringent leaves and bark are used, and the oak of the hills also yields a pure tanning material. Samples of these are sent both from the Simla and Hazara forests.

A specimen of acorn-cups, and the astringent principle extracted from them, were sent from Simla, but unfortunately they could not be found in the collection, and so escaped the notice of the Jury.

One of the most valuable products is the "kath," or catechu, obtained from the *Acacia*

catechu, by inspissating the infusion of the wood chips. "Kath gulábí" is the pure and superior article, of a pink or whitish color, while common "kath" is the inferior article much mixed with earth and twigs. There is no sample of the areca palm catechu, but some of the samples under the head of Gums, and called "mochras" were found to be black and highly astringent galls, like excretions of the areca palm. These are sometimes called "phúl súpyári" (flowers of the betel nut), but are only used in medicine.

A solitary specimen of the "malla bark" (*Zyzyphus nummularia*) was sent from Jhilam, and the stringent bark of the "amaltás" (*Cathartocarpus fistula*) completed the collection of barks.

The juice of the "ak" plant (*Calotropis*), is used in the process of dyeing leather red, and is for that purpose combined with salt. There is no specimen that calls for any special mention, beyond the tannin of Simla, which it is much to be regretted did not appear, and the curious light bark of the "chír" from Hazara.

B. POWELL,

Reporter to the Jury.

CLASS IV. SUB-CLASS (E). TEXTILE AND FIBROUS SUBSTANCES FOR PAPER, BASKETS, ROPE, &c., &c.

FIBRES are either cellular in their structure like the cotton, *Bombax* cotton, mádar fibre; or consist of woody tissue or fibre like the lotus fibre, flax, hemp, jute, san, &c., &c., but the cellular fibres are not the product of stem or leaves, but of the seed vessels, &c. Plants whose stems and leaves are simply formed of cells or vessels, yield no fibres.

Of the great divisions of plants, classed according to their growth, the first or *Acrogens*, whose growth is at the summit by the junction of the base of the leaves at the top of the stem—none yield fibres.

The second, *Endogens*, which grow from inside, that is the leaves (whose venation and fibres are parallel and longitudinal, like the fibres of their true stems) enter the cellular system of the stem, and are thence pushed outwards by new growth from the inside, like all aloes and palms, which have no regular bark, but a hardened outside, caused by the leaves being pushed out, by the tier which springs above them from the inside, and that tier again by another, and so on. Of this class, the leaves of many species of pine apple, *agave*, &c., yield valuable fibres, by removal of the vascular and cellular portions by means of pressure and washing; or, as in the case of grasses, the fibre and cellular are allowed to dry together, the leaf not being succulent enough for the sap to promote the decay of the fibrous portion; these grasses then make strong ropes. *Exogens*, which grow from the outside, by rings forming as on trees, have regular bark. The outside is cellular and useless, but has fibres inside which, when the bark is peeled off, can be separated, as in jute, flax, hemp, &c. This is very well exemplified in the structure of the hemp stalk. At the centre we have a hollow, or a light pith; the pith is next surrounded by a cellular substance with a little woody fibre, this is called, the *reed*, *boon* or *shove* of the hemp. Then comes the series of parallel fibres, which are the valuable part; and then a cellular cuticle, which has to be separated from the fibre by steeping, &c., this answers to the outer cellular bark of exogenous trees. Many barks of trees have the inner fibrous portion so strong and tenacious, and the outer or cellular portion so comparatively reduced, that the bark yields a strong rope material as it is, such are the *Grewia* and *Bauhinia*, and "dhák" bark ropes, &c., &c.

This large and important class may be subdivided for convenience of reference into—

I. Textile fibres—those suitable to the production of cloth, &c.—Cotton, flax, mádar fibre, nettle fibre, and a few rarer ones.

II. Fibres suited for making ropes and mats.—San, hemp, sanukra (*H. cannabinus*), aloe fibre, múnj grass, &c.

III. Fibres suited for paper making—*Daphne*, *Desmodium*, &c.

IV. And somewhat separated from the first, substances used in platting and making mats, fans, and baskets, and in thatching roofs.

It is not intended that fibres distributed under each head serve for no other purpose but that therein indicated; as a rule the fibres in any one division serve more or less for

the purpose of the other divisions below it, except perhaps the last or fourth, which is on the verge of being out of the province of fibres (properly so called), altogether; for instance, cotton, though distinguished by its prominent quality of affording a series of fabrics will, nevertheless, yield a good rope, and its rags, a good paper. The same with flax and the rest.

Taking then the fabrics under these divisions we have specimens as follows:—

I. TEXTILE FIBRES.

1731.—Cotton (*Gossypium herbaceum*, and allied species). *Vern.*—Rúí (Hind.); rúń (Punjabí); pambah (Persian); kurtam (Arab.) The plant, kapás or kapáh. The seed alone, banaulah, kapáh bíj.

Space forbids me to enter on a consideration of the evidence as to cotton being indigenous to India or not, but at the same time the question has been so well discussed, that it will be hardly too much to assert that there is every reason to believe that species of cotton *are* indigenous to India, and also to America; but that the species now recognized as American differ in character from all the known Indian species.*

The earliest name by which the ancients of Europe were acquainted with cotton is "carbasos." Evidently the Sanscrit "karpasi;" and not only have we STRABO'S accounts of cotton fabrics in India, but HERODOTUS in his account of the Indians, mentions that "they possess a kind of plant which, instead of fruit produces wool of a finer and better quality than that of sheep, of this the natives make their clothes."

The same author makes no allusion to cotton in Egypt, though he pointedly does to linen; and no cotton fabric has ever been found on Egyptian mummies.

PLINY† indeed speaks of a plant called "gossypium," having a nut, from the inside of which a wool‡ is obtained; but this author did not write till 500 years after HERODOTUS, and cotton was in that space probably introduced by reason of the Indian trade.

Besides the indigenous species of cotton (*G. indicum*) of late years other varieties have been introduced, such *G. barbadense*, the source of Sea Island, Upland Georgia and New Orleans§ cottons; *G. peruvianum* of Mexican and Peruvian cotton; *G. hirsutum* of Shanghai or Nankin cotton. All these varieties have succeeded and acclimatised more or less well; the Sea Island kind perhaps being an exception.

The distribution of cotton over the world is very remarkable, and is thus described by ROYLE.*

In a cultivated state, cotton is now distributed over a very wide expanse of the globe on both sides of the equator: on the north, extending as far as the Southern shores of Europe, and on the south to the Cape of Good Hope; in the islands of the Pacific Ocean, it is found both in the Friendly and the Society Islands. Nearly under the line, it is cultivated in the islands of Celebes, Java, Timor, and the Seychelles, as well as in Kutung, where the best is said to be grown, extending northwards up the Malayan Peninsula, along the coast of Tenasserim into the Burmese territory, and from this westward, into Siam and China, whence there is a peculiar species. Cotton is common in every part of India; a wild species was found in Ceylon, and another in Silhet by DR. ROXBURGH. From India the cotton seems to have travelled by the way of the Persian Gulf into Arabia, as well as into Persia, and from thence to Syria and Asia Minor. From Arabia and from the ancient commerce by the Red Sea with India it was probably introduced into Egypt, whence it seems to have spread into the interior of Africa, and to both its western and northern coasts. The islands and shores of the Mediterranean long supplied Europe with all the cotton it required; during the reign of NAPOLEON, he caused it to be introduced into Corsica, Italy, and the southern parts of France; and MR. KIRPATRICK cultivated it in Spain, near Malaga. In America, cotton is extensively cultivated in the Spanish, Portuguese, Dutch, and English settlements; also in Mexico and the Southern States, as Georgia and Carolina of the United States of North America. One species is peculiar to Peru; others are cultivated in the West Indian Islands.

In the case of cotton, where varieties introduced from other countries are confessedly our greatest hope, it becomes of first rate importance to notice the conditions under which the best varieties thrive.

We cannot hope to arrive at any general principles that will equally apply to all cotton crops, since the conditions under which cotton will grow are so widely different. HUMBOLT saw cotton on the Andes, at

* ROYLE'S Illustrations, I., p. 86.

† Lib. 19-I., quoted by ROYLE.

‡ It is remarkable that this idea of vegetable wool is preserved in the German, Dutch, and Swedish names for the cotton plant—Baumwolle, Boomwoll, Bomold.

§ BIRDWOOD, Bombay Products, 315; Saharanpoor Catalogue (JAMESON), p. 72.

* Illustrations p. 86.

9000 feet; on the Himálaya it is found at 4000. Cotton flourishes also in the rich basaltic soils of Central India, and again on the sea-shore tracts of the Sea Islands. But conditions favorable to development can be noticed, and methods of cultivation indicated.

HUMBOLDT gives as the zone of production for the species *G. barbadense, hirsutum,* and *religiosum* as from 0° to 34° of latitude. But *G. herbaceum* grows up to 37° in America, and to 46° near Astrakan.*

The British possessions are all within these limits, extending from 8° to 31°.

As to atmospheric conditions affecting its growth, it is quite unsafe to enter on specialities. No differences could be conceived greater than must exist between the Andes at 9000 feet, the plains of Central Peru at sea level; between the sea coast of the Sea Island, the plains of the Sind Ságar Doab, and the districts of Tinevelly; yet in all these cotton of excellent quality is produced.

But though such general principles of latitude and climate cannot be established with regard to cotton, there are principles which can, and these are well pointed out by DR. ROYLE in the following passage:—

"Much, therefore, may be done in improving the kinds which already exist in India, by ascertaining with precision the parts of the country where the best cotton is already produced, the peculiarities of soil, climate, and culture: by selecting the most prolific plants, and extending their cultivation, to the exclusion of less fertile and inferior kinds; exchanging the produce of one place with that of another, when others can be induced to take the same trouble in selecting and preserving only the best kind of seed. Doing in fact, what is everywhere done by all who are interested in the improved cultivation of grain, vegetables, fruit or flowers; though some varieties are difficult to propagate by seed, yet others may be continued sufficiently long to attain the permanency of species, instead of the liability to change of varieties.

"Much, moreover, may be effected by introducing into India the different species and varieties which are already successfully cultivated in other countries; and here the chief thing is not to restrict ourselves to too small a number of varieties, because they happen to be those which at present produce the best kinds of cotton. Not contented in America with possessing already the best kinds of cotton, they have tried those of other countries to see if there were not among them some suited to the peculiarities of their country and climate."

* ROYLE.

Following out these principles, much has been done of late years to import good seed and distribute it. The kinds have been principally—New Orleans and Georgian, a little Mexican and Nankin, and some Egyptian seed; the Sea Island seed has failed.

Much also has been done to improve the cultivation; and clear and simple instructions has been translated into the vernacular, and printed for distribution.

The native cotton is chiefly distinguished by its short staple and somewhat coarse fibre; it is sown by a most wasteful process broad cast, whereas the simple plan of making holes in lines at fixed distances apart, and dropping 4 or 5 seeds into each, is found not only to consume far less seed, but to produce much more healthy and satisfactory plants.

The native method of cultivating cotton is much the same everywhere, and broad cast sowing is equally in vogue. MAJOR CLARKE'S account of cotton cultivation, which may not be easily accessible to many readers, is here extracted.

"Cotton is sometimes cultivated as an unirrigated crop in the villages on the edge of the bar, and within it, it is also occasionally kept on for a second year's crop, the latter being un-irrigated; as a primary process, the land is well ploughed three or four times, and then levelled. In "chahí," or irrigated lands, a portion of the land ploughed for the wheat crop is reserved for cotton; sometimes, indeed, the young wheat is ploughed in twice, the land levelled, and the cotton seed mixed with dried and powdered cow-dung sown broad cast in the month of Phágan; four hand-hoeings are given, some cultivators manure before, some after, sowing. The seed when first sown requires but little watering, subsequently water must be given every fifth or sixth day. The first gatherings begin in Asauj or Kartak, according as the crop may be of the first or second year's growth. In this perguna the cotton is gathered every eighth day, in many others every fourth day. The average quantity of seed is eight seers per acre; a cotton gatherer (girl or woman) receives one seer of cotton per diem; sometimes it is gathered at one-eighth of the produce, which averages:—

"In khadir lands, ...	6	mds. per acre.
Bangar ditto, ...	8	„ „
Lands bordering on or within the bar, ...	10	„ „

"The gathering is continued to the end of Maghar."

Of such cultivation the profits and costs are calculated by the same writer, as follows, on 2 acres of cotton:—

Produce.	R	A.	P.	Cost.	R.	A	P.
First-rate crop, 24 maunds, ..	48	0	0	Revenue, 12 to 16, say, ...	16	0	0
				Putwari, ...	0	8	0
				Lumberdari malba, ...	1	9	6
				Road Fund, ..	0	2	6
				Seed, 16 seers, ..	0	8	0
				Hand-hoeing, at six annas per kanál, ...	8	0	0
				Gathering cotton, at 18 seers per kanál, ...	14	6	6
				Rupees, ..	39	2	6
Total, ..	48	0	0	Gross profits, Rs.,	8	13	6

The total area under cotton cultivation in the Punjab was in 1861, 547,414 acres, against 481,351 the year before, and 467,500 before that.

In the Punjab Proper the sowings begin as early as February 18th, and go on till the end of March, and in well watered (chahí) lands, to April and May.

In Delhi division the sowings extend into July, and do not begin till the middle of May, at the earliest.

In Dera Ghází Khán the sowings are late, as the crops are dependent on the rise of the inundation canals.

The picking is in October, November and December, and sometimes begins as early as September, frost and excessive cold being injurious. The cotton should be all picked before January.

The cotton plants generally last one year only; if they grow for a second crop, the produce is less than the first year by from one-third to one-fourth, but ripens somewhat earlier.

In Dera Ismaíl Khán and Bunnoo, the plants stand for three years, and the second year's crop is the heaviest.

The power of the cotton plant to sprout up again, and bear fruit year after year, is curiously illustrated by what took place at Gurdaspúr. In Batála, about 7 or 8 years ago, a distribution of good seed was made by J. H. PRINSEP, ESQ., and the people who received it still grow plants therefrom. This plant when properly treated does not deteriorate. There are 5 or 6 plants in Gurdaspúr, 5 years old, which fruit annually, with but slight difference in quantity and quality. The plants require the roots to be loosened and watered, and occasionally manured in proper seasons, and when the plants are healthy, the produce is close on 8 maunds per acre.

From recent returns, it was observed that the districts of Rawalpindi and Amritsar showed the greatest area cultivated with cotton, and Peshawur the least; Rohtak, Gurdaspúr, and Ambálah may have the greatest area in proportion to other crops. In Simla and Sirsa cotton was hardly grown at all.

The late Exhibition, however, contained samples from several of the Hill States of Simla.

The quantity of cotton exported is not at all in proportion to the produce. Out of 540,000 maunds produced, it was said that less than 100,000 maunds reached Calcutta and Bombay.

The land exports of cotton are from Delhi—to Rohilkund to Benares and Calcutta.

Gurgaon, Kurnal } Mirzapúr and the Punjab Proper.

Rohtak—Punjab Proper and Lower Provinces.

Jálandhar—to Hushyarpúr, Kangra and Firozpúr.

Sealkot—to Multán, Jammú, and the Salt Range.

Gurdaspúr—to Lahore.

Lahore—to adjoining districts.

Gujranwalla—to Sindh, the Salt Range, and Peshawar.

Rawalpindi—to Peshawar and Kuhát.

Gujrát—to Kashmír and the Salt Range.

Shahpúr—to Kábul, Jhang and Múltán.

Múltán—to Karáchí, Bombay, Deraját and Bhawalpúr.

Muzaffargarh—to Sindh.

Deraját and Bunnoo—across Sulaimaní Hills to Sindh—also to Kárachí and Bombay, and to Peshawar, and Kuhát.

Hazára and Peshawur—to Afghanistán, Swát, &c., &c.

I have taken occasion to reprint two valuable statements, showing the yield of cotton crops in the Punjab. The first shows the results of the years 1861-62. In this table, it should be added, that the averages produce per acre varied from 3 maunds (240 lbs.) in Hushyarpúr to 16 seers (32 lbs.) in Kangra.

The second table is a very complete one, published in the Financial Commissioner's Circular, No. $\frac{20}{1100}$ dated 9th March, 1867. The table shows the comparative results in the years 1864-65-66.

Division.	District.	Probable total produce of cotton fibre during 1861.	Quantity of cotton without the seed gathered from the late crops.	Quantity retained for home use.	Quantity exported.	Average price per maund.
		MDS.	MDS.	MDS.	MDS.	RS. A. P.
Delhi.	Delhi, ...	11,050	8,179	6,359	1,820	12 8 0
	Gurgaon, ...	37,308	25,310	13,310	12,000	14 0 0
	Karnal, ...	22,957	16,038	10,692	5,346	12 8 0
	Total, ...	71,315	49,527	30,361	19,166	..
Hissar.	Hissar, ...	7,272	8,275	8,275	..	13 8 0
	Rohtak, ...	48,174	33,448	15,558	17,890	14 0 0
	Sirsa, ...	158	..	..	..	..
	Total, ...	55,604	41,723	23,833	17,890	..
Ambálah.	Ambálah, ...	49,738	36,000	8,000	28,000	14 0 0
	Ludhiana, ...	45,422	47,000	10,500	36,500	14 8 0
	Simla, ...	250	..	..	..	..
	Total, ...	95,410	83,000	18,500	64,500	..
Jalandhar.	Jálandhar, ...	19,660	23,623	17,283	6,340	13 9 4
	Hushyarpúr, ...	18,025	21,000	21,000	..	13 5 4
	Kangra, ...	4,476	..	..	..	..
	Total, ...	42,161	44,623	38,283	6,340	..
Amritsar.	Amritsar, ...	32,290	12,220	8,480	3,740	14 0 0
	Gurdaspúr, ...	21,928	28,712	18,807	9,905	16 0 0
	Sealkot, ...	30,332	20,631	12,641	7,990	18 0 0
	Total, ...	84,550	61,563	39,928	21,635	..
Lahore.	Lahore, ...	16,428	12,144	7,894	4,250	18 0 0
	Gujranwalla, ...	18,107	15,000	10,000	5,000	17 0 0
	Ferozpúr, ...	12,000	10,473	3,700	6,773	17 8 0
	Total, ...	46,535	37,617	21,594	16,023	..
Rawalpindi.	Rawalpindi, ...	13,963	13,091	10,391	2,700	16 0 0
	Jhilam, ...	15,676	16,000	16,000	..	15 2 3
	Shahpúr, ...	27,093	21,622	5,329	16,293	17 0 0
	Gujrát, ...	21,156	20,998	7,473	13,525	17 0 0
	Total, ...	77,888	71,711	39,193	32,518	..
Múltán.	Múltán, ...	26,325	16,815	8,351	8,464	16 9 10
	Jhang, ...	21,016	15,393	9,180	6,213	16 0 0
	Gugaira, ...	11,870	8,912	6,998	6,914	18 4 0
	Muzaffargarh, ...	15,997	14,200	4,600	9,600	17 to 20 0 0
	Total, ...	75,208	55,320	29,129	26,191	..
Dera-ját.	Dera Ismaíl Khán, ...	14,238	6,500	2,560	3,940	23 0 0
	Dera Ghází Khán, ...	16,146	17,130	5,000	12,130	25 0 0
	Bunnoo, ...	5,182	4,495	2,332	2,163	24 0 0
	Total, ...	35,566	28,125	9,892	18,233	..
Peshawur.	Peshawur, ...	9,918	13,790	7,030	6,760	20 2 8
	Hazara, ...	7,240	4,207	4,207	..	16 0 0
	Kuhát, ...	1,069	2,475	995	1,480	26 8 0
	Total, ...	18,227	20,472	12,232	8,240	..
	Grand total, ..	6,02,466	4,93,681	2,62,945	2,30,736	..

With reference to the second table which follows, the circular quoted makes the following statement.

"The information relates to the season ending with the autumn of 1866, when the crop is ready to be picked. Though the replies were not received in a complete state till recently, they are based on information derived before the out-turn of the season could be known, and before the effect of the recent and still existing drought could be determined. It s therefore quite possible that the actual out-turn is not only less than the preceding year, but less than was at one time anticipated with regard to the season under report.

"As to ascertain the actual out-turn would only cause further delay, the information already obtained is published as it is, and may be accepted for what it is worth.

"The area under cotton cultivation is shown to be 624,193 acres. The area shown in last year's report was 625,035, which is amended in the present report to 613,262. There has therefore been an increased area sown—but the area is still only about three-fourths of what it was in 1864-65, when the cotton trade was at an unnatural height.

"The fact that there is no falling off in the area sown shows that the cultivation is one steadily relied on by agriculturists. The violent re-action which followed the close of the American war and the failures in Bombay has now been fairly tided over, and unless some convulsion of similar character should recur, of which there seems to be no reasonable apprehension, the cultivation is likely to maintain a steady position.

"The prices of the past year do not show such violent fluctuations as they did in the two preceding years.

"The average wholesale price for the province is shown to be Rs. 16-2-6 per maund, against Rs. 20-12-7 the preceding year. The average founded on the averages of the ten divisions is nearly the same as that founded on the figures of the 32 districts, but if the details be scrutinised, it will be seen that there are great differences between districts, even within the same division. Thus, for instance, in the Múltán district, the wholesale price reached Rs. 30 a maund, and in Muzaffargarh it reached Rs. 25—but in Montgomery and Jhang, within the same division, the price was only Rs. 18. Similarly, in Gurdaspúr the highest wholesale price was Rs. 22, while in the neighbouring district of Sealkot it was only Rs. 15.

"The lowest wholesale prices, as may be expected, do not show such great variations as the highest, as a minimum value is more easily found than a maximum. Except in the Peshawur division, which shows an exceptionally high rate, the lowest wholesale price may be said to range from Rs. 10 to 14 a maund.

"The Deputy Commissioner of Ambálah remarks, that when the English price for fair Bengal cotton is at 8*d.* a pound, equal to Rs. 26-10 a maund, there would be an ample margin for profit for cotton priced here at Rs. 14 to 16 a maund. It may be inferred therefore, that cotton has not, during the past year, fallen in price below that point when it would cease to be remunerative. In cases where prices ranging from Rs. 20 to 30 a maund have been realized, the profit on the transaction must have gone to the producer, and where the local purchaser has obtained the cotton at from Rs. 10 to 14, the lowest wholesale rates, the profit must have been secured chiefly by him; even on the average rates, both the producer and the local purchaser must have been secured from loss.

"Only one officer, the Deputy Commissioner of Jhilam, alludes to advances made by money lenders to cultivators, and considers that one reason for the great falling of in area in his district is that the money lenders no longer find it so profitable to encourage agriculturists to grow cotton on their account by means of advances. The Rawalpindi division produces more cotton than any other, but the same falling off is not observable in the other three districts that has occurred in Jhilam. Most of the other divisions, and, in particular, Delhi and Ambálah show a large increase.

"It may be noted here that, while in the Punjab returns, the out-turn is shown as less than a maund an acre, in the North West Provinces the out-turn is usually rather more than a maund an acre.

"Precise information has not been obtained as to whether local demand for local consumption has increased, but it seems probable that it has, as local consumers could not afford to buy much cloth when the price was at its height last year and the year preceding, and as the price has fallen they have probably purchased more largely for private use.

"It was estimated last year, that the area under cultivation would yield about 500,000, or somewhat more than three-fourths of a maund an acre; owing to the drought it is not likely that the out-turn of the present year has been so great. It may be estimated about 400,000 maunds. Last year it was calculated that about half the entire quantity would be available for export. This year, it seems likely that, as the English price has fallen, and the local demand has increased, a smaller amount will be available.

"It has been ascertained from the annual returns of the Boat Trade on the Indus, furnished to this office, that about 100,000 maunds of cotton were carried down the river during the year 1865-66. Re-

turns obtained from the Agents of Steam Companies in Múltán show that in 1865-66, the quantity of cotton carried down the Indus was 158,966 maunds, of which the Indus Flotilla Steamers carried 96,495, and the Oriental Inland Steam Navigation Company's Steamers, 62,471. This added to the 100,000 maunds reported to have been carried by boats, gives the total export as 259,976, which is almost exactly the amount estimated by the Financial Commissioner in last year's report.

"The export by steamer has increased greatly of late years, as the following figures of the Oriental Steam Navigation Company will show. The figures of the Indus Flotilla for those years are not available.

1862-63.	1863-64.	1864-65.	1865-66.
Maunds.	Maunds.	Maunds.	Maunds.
19,837	50,748	14,798	62,471

"The returns of the Firozpúr bridge-of-boats show that cotton is chiefly carried down the river in the first quarter of the year. The quantity carried from July to December 1865, was only maunds 8,281, while in the three months of January, February and March 1866, the quantity was 43,467 maunds. The total for the year ending 30th April, 1866, was 64,421 maunds. This quantity is included in the lakh of maunds registered at Mithankote.

"If the out-turn of cotton is anything like what it was last year, or say, allowing for unfavorable weather, 450,000 maunds, it may be estimated that about 200,000 maunds will be available for export, and the most of this must be already on its way down the Indus."

STATEMENT showing the estimated extent of cotton cultivation in the Punjab.

1	2	3	4	5	6	7			8			9			10
Division.	District.	Area estimated for 1865-66 (acres).	Rain-fall from 1st May to 1st November 1865.	Rain-fall from 1st May to 1st November, 1866.	Area estimated for 1866-67 (acres).	Highest wholesale prices of cotton per maund.			Lowest wholesale prices of cotton per maund.			Average wholesale prices of cotton per maund.			Abstract of remarks of Deputy Commissioners, as to present condition of crops and the prospects of a favorable out-turn or otherwise.
						1864-65.		1865-66.	1864-65.		1865-66.	1864-65.		1865-66.	
DELHI.	Delhi, ...	12,648	27	26	17,729	35 9 0		16 0 0	8 0 0		8 5 0	21 12 6		12 2 6	A favorable out-turn anticipated.
	Gurgaon, ...	10,989	25	31	33,172	25 0 0		16 0 0	18 0 0		13 0 0	21 8 0		19 8 0	Prospects favorable in pergunahs Noh, Ferozpúr and Pulwal, but unfavorable in Jharsa and Rewarí for want of rain.
	Karnal, ...	15,874	22	15	19,165	25 0 0		15 0 0	6 8 0		10 0 0	15 12 0		12 8 0	Though the area brought under cotton is more than in the preceding years, yet the out-turn of the crop is below the average, owing to dearth of rain.
	Total, ..	39,511	..	..	70,066	35 9 0		16 0 0	6 8 0		8 5 0	19 10 10		14 11 6	
HISSAR.	Hissar, ...	8,993	23	10	9,385	32 0 0		25 0 0	12 0 0		10 0 0	22 0 0		17 8 0	The present condition of the crop is bad owing to want of rain.
	Rohtak, ...	16,913	17	11	35,397	27 0 0		17 0 0	8 0 0		11 0 0	17 8 0		14 0 0	Ditto ditto ditto.
	Sirsa, ...	..	16	11	225	28 0 0		18 0 0	12 0 0		10 10 8	20 0 0		14 5 4	This is not a cotton producing district.
	Total, ..	25,906	..	..	45,007	32 0 0		25 0 0	8 0 0		10 0 0	19 13 4		15 4 5	
AMBALAH.	Ambálah, ...	27,067	37	23	38,258	27 0 0		20 0 0	11 0 0		10 0 0	19 0 0		15 0 0	A fair average out-turn is expected.
	Ludhiana, ..	7,701	15	19	9,414	19 0 0		18 0 0	12 0 0		14 0 0	15 8 0		16 0 0	About ⅓ of the cotton will be used in the district and ⅔ exported.
	Simla, ...	3,050	56	47	3,192	28 1 0		20 0 0	7 0 0		5 0 0	17 8 6		12 8 0	No remarks.
	Total, ..	37,818	..	..	50,864	28 1 0		20 0 0	7 0 0		5 0 0	17 5 6		14 8 0	

1	2	3	4	5	6	7						8						9						10
Division.	District.	Area estimated for 1865-66 (acres).	Rain-fall from 1st May to 1st November, 1865.	Rain-fall from 1st May to 1st November, 1866.	Area estimated for 1866-67 (acres).	Highest wholesale prices of cotton per maund.						Lowest wholesale prices of cotton per maund.						Average wholesale prices of cotton per maund.						Abstract of remarks of Deputy Commissioners, as to present condition of crops and the prospect of a favorable out-turn or otherwise.
						1864-65.			1865-66.			1864-65.			1865-66.			1864-65.			1865-66.			
JALANDHAR.	Jálandhar, ..	26,543	20	21	27,697	18	0	0	19	0	0	11	4	0	12	0	0	14	10	0	15	8	0	Aspects of the crop are medium, owing to want of rain.
	Hushyarpûr, ..	33,970	25	26	25,855	32	0	0	20	0	0	14	0	0	12	0	0	23	0	0	16	0	0	Condition of crops good, and a favorable out-turn expected, though the area sown is less than last year.
	Kangra, ...	15,141	81	47	4,250	20	0	0	20	0	0	20	0	0	10	0	0	20	0	0	15	0	0	The small cultivation this year is owing to want of rain at the proper time, but the crop is good.
	Total, ..	75,654	..	..	57,802	32	0	0	20	0	0	11	4	0	10	0	0	19	3	4	15	8	0	
AMRITSAR.	Amritsar, ..	36,292	19	22	24,391	29	0	0	20	0	0	12	5	3	12	2	3	20	10	8	16	1	2	
	Gurdaspúr, ..	No records kept of this year's return.	13	27	24,706	20	0	0	22	0	0	12	0	0	14	0	0	16	0	0	18	0	0	Prospects good.
	Sealkot, ...	37,350	19	28	34,677	16	0	0	15	0	0	11	0	0	12	0	0	13	8	0	13	8	0	
	Total, ..	73,642	..	..	83,774	29	0	0	22	0	0	11	0	0	12	0	0	16	11	7	15	13	9	
LAHORE.	Lahore, ...	31,971	16	11	43,341	32	0	0	19	0	0	14	0	0	10	0	0	23	0	0	14	8	0	Every prospect of a good crop.
	Ferozpúr, ..	15,792	35	10	11,835	28	0	0	20	0	0	11	0	0	10	0	0	19	8	0	15	0	0	Present condition of crop very poor for want of rain, out-turn will be much below the average.
	Gujranwalla, ..	24,174	22	19	22,465	17	0	0	15	0	0	12	0	0	13	0	0	14	8	0	14	0	0	
	Total, ..	71,937	..	..	77,641	32	0	0	20	0	0	11	0	0	10	0	0	19	0	0	14	8	0	

RAWALPINDI.	Rawalpindi, ..	28,455	16	21	26,934	27	0	0	20	0	0	14	0	0	10	0	0	20	8	0	15	0	0	Crops have suffered for want of timely rain, out-turn unfavorable.
	Jhilam, ..	41,620	26	18	24,731	33	0	0	18	0	0	21	8	0	13	8	0	27	4	0	15	12	0	The yield this year is small, owing to want of rain during August and September.
	Gujrát, ...	41,634	22	22	38,029	25	0	0	16	0	0	13	0	0	12	0	0	19	0	0	14	0	0	Though the crops have suffered from drought in some localities, yet an average out-turn is expected.
	Shahpúr, ..	24,729	10	7	18,643	25	0	0	18	0	0	14	0	0	14	0	0	19	8	0	16	0	0	The out-turn will be very small, owing to the great drought this year.
	Total, ..	1,36,438	..	..	1,08,337	33	0	0	20	0	0	13	0	0	10	0	0	21	9	0	15	3	0	
MULTAN.	Múltán, ..	18,322	1	2	17,207	43	0	0	30	0	0	16	0	0	14	0	0	29	8	0	22	0	0	The crops have slightly suffered this year, owing to the canals having been closed earlier than usual.
	Jhang, ...	15,535	8	3	12,867	21	0	0	18	0	0	16	0	0	12	0	0	18	8	0	15	0	0	The crop is good, but the area under cultivation less than in previous year, want of rain being the chief cause.
	Montgomery, ..	7,871	6	4	11,530	20	0	0	18	0	0	12	0	0	13	0	0	16	0	0	15	8	0	Crop favorable and the out-turn expected will be realized.
	Muzaffargurh, ..	22,430	1	4	29,700	40	0	0	25	0	0	19	0	0	10	0	0	29	8	0	17	8	0	No remarks.
	Total, ..	64,158	..	..	71,304	43	0	0	30	0	0	12	0	0	10	0	0	23	6	0	17	8	0	
DERAJAT.	Dera Ismaíl Khán,	37,521	2	2	18,893	32	9	4	22	0	0	14	0	0	11	8	0	23	4	8	16	12	0	The out-turn will not be so favorable as in the preceding year, owing to the scarcity of rain.
	Dera Ghází Khán,	13,512	1	5	11,475	38	0	0	25	0	0	15	0	0	10	0	0	26	8	0	17	8	0	The condition of crops good, favorable out-turn is expected.
	Bunnoo, ...	13,429	6	4	8,571	30	8	0	20	0	0	19	0	0	13	0	0	24	12	0	16	8	0	Crops not so good as last year, prospects of out-turn unfavorable.
	Total, ..	64,462	..	..	38,939	38	0	0	25	0	0	14	0	0	10	0	0	24	13	7	16	14	8	

1	2	3	4	5	6	7						8						9						10
Division.	District.	Area estimated for 1865-66 (acres).	Rain-fall from 1st May to 1st November, 1865.	Rain-fall from 1st May to 1st November, 1866.	Area estimated for 1866-67 (acres).	Highest wholesale prices of cotton per maund.						Lowest wholesale prices of cotton per maund.						Average wholesale prices of cotton per maund.						Abstract of remarks of Deputy Commissioners, as to present condition of crops and the prospect of a favorable out-turn or otherwise.
						1864-65.			1865-66.			1864-65.			1865-66.			1864-65.			1865-66.			
PESHAWUR.	Peshawur, ..	13,175	4	4	13,988	29	0	0	23	0	0	20	0	0	19	0	0	24	8	0	21	0	0	Present condition of crops good, prospects of out-turn favorable.
	Kuhát, ...	4,339	9	12	2,846	40	0	0	27	0	0	20	0	0	20	0	0	30	0	0	23	8	0	No remarks.
	Hazára, ...	6,522	21	17	3,625	22	0	0	20	0	0	20	0	0	20	0	0	21	0	0	20	0	0	Prospects unfavorable, out-turn rather below the average.
	Total, ..	23,736	..	..	20,459	40	0	0	27	0	0	20	0	0	19	0	0	25	2	8	21	8	0	
	Grand Total,	6,13,262	..	..	6,24,193	43	0	0	30	0	0	6	8	0	5	0	0	20	12	7	16	2	6	District average.
		..	..	..	..	0	0	0	0	0	0	0	0	0	0	0	0	20	10	9	16	2	4	Divisional average.

FINANCIAL COMMISSIONER'S OFFICE,
LAHORE, *The 9th March*, 1867.

In concluding these notes on cotton culture, it will be well not to overlook the difficulties the farmer has to contend with, hence I extract from the Proceedings of the Agri.-Hort. Society, Punjab, the following notes on *blight* of cotton.

The following papers were forwarded for the consideration of the Society, by the Financial Commissioner.

The first is by Dr. JOHNSTONE of Gujrát:—

"The cultivation of Indian cotton *(Gossypium arboreum)* has during the course of the unfortunate American war, extended considerably in the Punjab; during the last two years cotton-farming by occupying tracts formerly yielding pulse and grain has increased the market rate of these life necessaries. It has moreover yielded an easy and a steady profit, but in common with other plant life, it is liable to disease.

* * * * * *

"Cotton is sown in March and April, and reaped from October to December, from its first growth to seeding it is a prey to parasites.

"1. The larva of the *Helicopis cupido* attacks the sapling in its bud.

"2. The larva of the *Deprescaria gossipiella* (weevils), the seeds in harvest; these are the 'toka,' of the natives.

"3. As the rainy season approaches, the hairy caterpillar (bhúngo) appears preying on the stem leaves, but has powerful enemies to contend with. The minar and tilies (Indian starling) feast on them; the former only to allay hunger, the latter partakes sparsely, but remorselessly destroys multitudes.

"4. The disease which bids fair to destroy ¾ths of this year's cotton crop is 'thela.'

"Ever since cotton-farming, 'thela' has probably occasionally appeared, but with increased cultivation disease has multiplied apace.

"What then is the producing cause of 'thela,' and what its cure?

"On examining a typical leaf of the cotton plant effected by 'thela' we find---

"1st.—Part of the leaf yellow and crumpled, the nutrient sap being withdrawn, it has withered and died.

"2nd.—Part of the leaf blackened, mortification patches, the stage preceding death.

"3rd.—A quantity of liquid substance resembling oil, hence the native name 'thela.'

"4th.—Part of the leaf frosted with lanuginous tufts.

"5th.—Part of the leaf covered with pale orange insects.

"The zemindars believe when rain is scanty and dew at a maximum, 'thela' is induced, but the *causus morbi* is a viviparous wingless parasite; the Aphis lanigera; possessing a flask-shaped body, six feet, two antennæ, two tubes at abdominal extremity, a haustellum for puncturing, and a sucker for extracting; and within this transparent sucker a perfect apparatus resembling a hand-pump; the sucker is fixed, the minature piston plays, and the sap—the life-blood of the plant—is absorbed.

"The extreme fecundity of the Aphides is remarkable, both sexes only exist in autumn, and one congress with the male yields not only the primary young, but their young for six generations, when both sexes are again generated. * * *

"After pairing, the female deposits eggs, which in about four days animate. Immediately from every pore of their tiny bodies springs a cottony hoariness which daily increases until they are cradled in a downy bed; while in this snow-white cot,—which at once effectually conceals their nature and protects from climatic change, they prey upon the green leaves; they are more abundant on the under surface of the leaf, * * * * * where wind-force acts at a minimum upon their fairy feathered forms.

"Increasing with such amazing rapidity the sap is soon exhausted, mortification and blight results.

"As these atomic creatures age, their white plaster coats vanish; and pale-orange wingless insects appear, the 'koongee' of the Jats.

"When the female Aphis lanigera is crushed, the hand is stained a purplish red. Might she not yield a useful dye? It is worthy of note that this insect belongs to the same sub-order as the Mexican cochineal *(Coccus cacti)*, a parasite of the Nopale *(Cactus opuntia)*, and the Indian lac insect, Coccus lacca,—a parasite of the banyan *(Ficus religiosa)*; and in these instances the female only yields the dye.

"The 'thela' oily honey-dew found on the leaves, is secreted from the abdominal tubes of the female Aphis, and exists in abundance. Ants prize it, and devour it greedily whenever a colony of Aphides exist; the red and brown ants (Formica rufa and fusca) wait upon them; should the 'thela' be scanty the ants stroke and fondle them with their antennæ until a supply is secreted.

"With regard to the influence of soil, the Aphis attacks the cotton crop of the 'rohí,' hard compact land, most severely; the 'mehra,' 'barani,' or soft, damp, loamy soil less so; and the 'retlí' or sandy, least of all.

"In autumn the 'toka' larva of Deprescaria gossipiella abounds in the 'retlí,' destroying the 'banola' or cotton seed. No parasite preys on the cottony fibre. It is insiped and lacks albumen.

"These parasites may be destroyed or kept at bay—

"I. The larva of *Heliocopis cupido*,—'toka,'—is put to flight by sprinkling ashes over the sapling.

"II. The hairy caterpillar, 'bhúngo,' possesses many natural enemies; if very abundant, pick them.

"III. The larva of Deprescaria gossipiella's predations can be effectually checked by scalding the banola before storing; this process destroys the larva, but does not impair the vitality of the seed.

"IV. The Aphis lanigera, the originator of 'thela,' does not exist in any cotton field growing in the proximity of hemp, 'sunn.' Some considerable time ago I remarked this in a small field to my own, in part of which hemp, 'sunn,' was growing, and experience has amply confirmed it.

"1. Hemp, 'sunn,' should be sown with cotton in adjacent ruts, or the plants will be drenched at stated intervals with a solution of the hemp leaf. Hing, 'assafœtida,' is more effective, but expensive, as it is a Kábul production.

* * * * * *

"3. Heavy rains wash off and wind-storms whirl their hoary cradles away, but many escape and redevelopment ensues.

"4. Beneficient nature has provided us with Aphidian enemies. One cannot examine a cotton plant without handling a few *Coccinella*, the lady bird beetle, or *Chyrosopus*, the lace wing, whose larva exclusively feeds upon the devastating Aphidian hordes, but the magical fecundity of the Aphis lanigera overbalances the rapacity of the hungry larva, and the laborer must either passively submit to a lost crop or by the sweat of his brow stave off impending ruin."

But MAJOR DWYER, Deputy Commissioner, Gujrát, in a letter, dated 16th November, forwarding the foregoing remarks:—

"I think the theory that the growth of 'sunn' with cotton would prevent the blight, requires more enquiry before it can be accepted as a proved fact, because I happen at the present time to be, and have been the last week, in the midst of the Lubana villages, the inhabitants of which grow 'sunn' largely, for making sacks for their pack bullocks; for one acre of cotton, I find at least five of sunn, either round and about the cotton fields, or contiguous to them, and I have found here and there a few cotton plants growing in a field of 'sunn.' 'Tela' blight is now past and gone, but the Lubana villagers all declare to me that their cotton was almost entirely destroyed by 'tela,' and if what they say is true, I doubt if the growth of 'sunn' would have any effect in preventing the 'tela' blight."

THE INTRODUCTION OF FOREIGN SEED as one of the best methods of developing the cotton resources of India, is urged with great force by DR. ROYLE, in his "Illustrations," which were published in 1839. He there mentions, besides, actual experiments at Allahabad and elsewhere, that in 1832 some imported seed was sown experimently near Delhi. The Royal Botanical Gardens of Saháranpúr have been, however, the centre of experiment; and for several years different varieties of cotton have been cultivated with success, and the acclimatized seeds distributed. In the Punjab, Leia was one of the first fields of experiment, and a sample of the cotton resulting is now preserved in the Lahore Museum. A similar sample of cotton from Gujrát of some years back is also preserved.

It is, however, only quite recently that the distribution of imported seed has been carried out on anything like a large scale. In the year 1863, a supply of cotton seed was announced, and it was bought up largely. Some zemindars at Lahore, would bid in excess of the upset price. The price of the cotton seed was already very high (nearly three times that of native seed), as the cost of carriage had augmented it. It must be confessed, however, that the demand for acclimatized seed is not yet very general. As a rule the people do not like to take the trouble necessary to ensure a good crop, and above all, they do not like to depart from the traditional methods of broadcast sowing, &c., which are less suited to the foreign seed. Some also complain that they cannot clean, and cannot spin the cotton when produced.

Among the various papers which have appeared detailing the results of the experiments in cultivating foreign cotton, there is one which appeared in the *Punjab Gazette*, August 28th, 1861, which deserves notice. As the paper may not be in the hands of every reader, I have made the following extracts from it.

"As cotton is the article of all others, regarding which most solicitude is at present felt, I will first make mention of it. MR. BERKELEY of Delhi has been engaged for two seasons in making a very spirited experiment with American seed, in a plot of five acres of ground, in the Botanical Garden, made over to him for this purpose. Mexican and New Orleans seed were sown the first year, and produced luxuriently, two bales of the produce being sent to Manchester; and in the second year, MR. BERKELEY found the results from the acclimated seed to be equally favorable; 500 rupees worth of the produce has been sold in all; but as the ground had to be newly prepared, and the experiment was on a very small scale, a still greater outlay was incurred, and MR. BERKLEY has been obliged, from various causes, to give up the undertaking.

"MR. HURST, a member of the Calcutta Agricul-

tural Society's Committee, who had just returned from Manchester, reported on a sample of the first year's produce, that such cotton is all that can be desired,—the very kind required by the Manchester spinners. The produce of the Mexican seed was perhaps considered in Calcutta on the whole the best, but it was suggested that the New Orleans would probably produce the more remunerative description. Both were valued at from 7*d.* to 7½*d.* per lb.; and DR. BROWN, Secretary to the Agricultural Society of Lahore, to whom I made over a specimen from the Pernambuco, has subjected it to examination under the microscope, and reports that the fibres, which measure from one inch to one and a quarter in length, appear uniform, free from knots and unmixed with dirt or extraneous matter. He considers it similar in quality to African cotton, valued in March 1859, at 7½*d.* per lb., while ordinary East Indian was priced at 6*d.* Some South Sea Island seed was also sown but did not germinate; likewise some Pernambuco, which though sown too late to yield a crop the first year, is said to have been very vigorous and in full bearing last year, the plants being about 10 feet high.

"MR. COPE, who created, and is in charge of, the Public Garden at Amritsar, also tried a like experiment last year, in a plot of that garden, with Mexican and New Orleans seed, and he informs me, that while the current price of country cotton with the seed, was 13 seers per rupee (*i. e.*, 13 lbs. per shilling) he was offered in the open market, a rupee for 8 seers (a shilling for 8 lbs.,) and if inclined to sell, he believes he could have got that price for 7 seers, the crop produced being at the same time double the usual crop of the country. Nevertheless, he has experienced, on the part of the zemindars, as has MR. BERKELEY, an indifference on the subject which disinclines them to pay for seed, and accordingly he has contented himself with extending his own experiment this year to 4 acres. MR. BERKELEY distributed a large quantity of seed to the zemindars, and sent some also to Roorkee and Dehra. The latter, under European superintendence, throve, while that distributed to natives appears to have been everywhere neglected.

"Government may no doubt do much by improving the communications, specially by water, towards promoting the growth of cotton or other bulky articles of raw produce, suited for the Europe market, and this is being done in all quarters, to the utmost limit that the means at the disposal of Government may permit. Something, too, may no doubt be done, by disseminating knowledge amongst the people, as to the requirements of England in this matter, and it is a gratifying fact, that, owing partly to this cause and partly to the peculiar character of the season which had lead to an unusual breadth of land lying waste, when the first falls of rain occurred, a larger crop has this year been sown in most parts of the Punjab than has before occurred within the memory of man."

The foregoing extract alludes to the experiments of MR. BERKELEY at Delhi, perhaps no experiment has been so fraught with valuable results deduced from it as that has. The remarks of MR. BERKELEY are so important that I give them in *extenso*—he writes—

"The results of my experiments with the different descriptions of cotton which I tried, may be briefly stated thus:—

"Indian cotton, ordinary crop, produced per beegah of 3025 English square yards, 12 maunds of kupás, yielding at from 12 to 14 seers of cleaned cotton per maund, from 3 maunds 24 seers to 4 maunds 8 seers, the cost of gathering having been previously paid out of the cotton. I forget, now whether an eighth or tenth of the quantity picked was the rate. These rates of produce are equivalent to from 5 maunds 30½ seers, to 6 maunds, 28¾ seers per acre. In maximum crops I have heard, and from my own observations believe, that the out-turn of cleaned cotton frequently is as much as 5 maunds per beegah or 8 maunds per acre.

"The Sea Island cotton, a most beautiful article of a transparent whiteness, with a slightly bluish tinge, affording the finest fibre, though perhaps not the longest staple, I found could not be depended upon. If I remember rightly, the imported seed did not germinate freely; and of the plants which came up, many were blasted by the first season of hot winds, and of those that survived the rains, many more were killed out and out by the frost of the ensuing winter; so that the results were extremely unsatisfactory. The seed of the first generation not succeeding better, I gave up this description altogether.

"The Nankin cotton was altogether a worthless product. The peculiarity about it was its rather deep red color which no bleaching could reduce, the color extending to the very seeds. Its yield did not exceed about 2 maunds per beegah of 3025 yards, and it was otherwise obviously unsuited to the soil and climate.

"The Egyptian cotton also did not promise well, while apparently suited to the soil and climate, and yielding a product somewhat superior; it seemed to possess no advantages over the common indigenous cotton of the country, which might be successfully attained by the improved cultivation of the latter.

The new Orleans cotton was the description, decidedly adapted for this country. The imported seed germinated freely; the yield the very first ga-

thering, that is in the autumn succeeding its sowing, was equal to, if not larger than, that of the indigenous article; the fibre was beautifully fine and smooth, and the staple from an inch to an inch and a half in length. Some staples of what I grew were sent to Manchester by MR. SMITH, and were declared to be barely inferior to the best description of extra fine, imported from the Southern States of America. The seeds of the first, second and third generations showed no perceptible deterioration, while the spring and autumnal gatherings, from the plants raised from the original imported seed, went on increasing yearly in quantity.

"The acre contains 4840 yards. As the natives sow cotton broadcast, I may say 9 plants at the very least might be assigned to each square yard. At this rate the plants should be of fair ordinary health and growth. Let it be assumed that each of these plants would bear at the lowest estimate 10 full and perfectly uninjured capsules, each capsule would give 27 seeds, and half the weight of the 27 seeds in cleaned cotton. The weight of the 27 seeds would be more than the tenth part of the rupee, as may be ascertained any day by weighing 250 healthy seeds taken from the cotton seed selling in the market, which would weigh about a rupee, hence the account for an acre would be thus: 9 plants in one square yard × 10 capsules from each plant × 27 seeds in each capsule = 2430 seeds ÷ 250 seeds weighing 1 rupee = (nearly) 10 rupees or 2 chittacks × 4840 square yards = 15 maunds 5 seers of cotton seeds, the produce of an acre, that is two-thirds of the gross out-turn in kupas, the remaining third, 7 maunds 22½ seers, being the cleaned cotton, the produce of an acre.

"The selection of the soil is by no means a difficulty; all varieties of equally productive soils have appeared to me equally well adapted for cotton. Thus, for instance, wherever sugar-cane, wheat or gram grows luxuriantly, it may be expected that cotton will thrive equally well.

"Out of the tropics the most appropriate season for sowing is from the 15th to the end of April. The sun has then acquired sufficient heat to produce healthy germination and time is gained to admit of the plants attaining a strength and growth qualifying them to resist the frost of the ensuing winter.

"The mode of sowing is the next matter. DR. ROYLE, in a paper on cotton cultivation drawn up in 1834, recommended sowing in lines to facilitate the circulation of air, and according to it, in most experiments which I have seen, the sowings have been in parallel drills from 2 to 3 feet apart, but beyond this there has been little or no attention to the preservation of uniform distances between the plants. For in the drills they have been in some places more or less crowded, and in some more or less apart. The American method, I believe is, and this is one I pursued, to have the field divided into square yards; to dig circular holes at the intersections of the lines forming the squares about a foot in diameter, and 6 or 8 inches deep; to have these holes half filled with rich mould, and the mould well mixed with the soil below. The holes are then watered to cause the mould to mingle well with the soil, and 15 days or so after the ground is fit for sowing. Six or eight selected healthy seeds are put down in each hole, at equal distances, about 2 inches under the surface. Eight or ten days after the seeds have germinated, two or three of the weakest plants should be pulled up out of each hole, and those remaining should be allowed to grow together for a week or so more, when another removal of the weakest plants from each hole should be made, and so on, till one, the healthiest plant of the lot, is left in each hole.

"After the plants have attained a growth of 10 or 12 inches, too much care cannot be observed in frequent weeding, cleansing the plant of decaying branches, leaves, flowers and capsules; and also in removing all decaying vegetable matter from the ground: care in this latter particular is of the greatest consequence to ensure good quality, as in case dry leaves or grass are allowed to lie about the roots, a peculiar species of insect is bred, which punctures the capsules, and deposits its larvæ inside. The larvæ are hatched into grubs in the capsule, and seriously damage the cotton in more respects than one."

The *price of cotton* has always been more or less subject to variation; but the excitement produced by the demand for cotton, resulting by the stoppage of the American supply during the war in America, caused a rise in price which was really wonderful. Even now the effects of that crisis are felt, and cotton seems to have permanantly attained a new and higher place in the market, the price once raised by the dearth during the war, has never returned absolutely to its original level. This period is too remarkable in the history of cotton to be left without notice.

The LOCAL COMMITTEE OF ROHTAK remark—

"Prior to the great demand for this staple for the home market, the cost of cotton with seed (uncleaned cotton) was from 18 to 22 seers per rupee, and clean cotton from 7 to 9 seers, now the former sells at 5 seers to the rupee, and cleaned cotton at only 1¼ seers per rupee."*

The Revenue Report for 1861-62, well describes the results of the excitement in the following paragraph:—

"The return for the present year, 1861, gives an

* Recently the price has been higher than this even.

aggregate of 5,47,414 acres, being an increase upon last year of 66,063 acres, which is much less than might have been expected from the most unprecedented prices which have latterly ruled in the markets; and the great excitement prevailing in regard to it at the Presidency towns more especially. Last year the price of cotton, as shown by the returns then submitted, ranged from 10 to about 12 Rs. per maund. Now the price of fair cotton at Kárachí has, I believe, risen from 25 to 30 rupees, and is expected to reach 35 or 40, if the excitement continue; and whereas at this time last year, the native dealers appeared quite unconscious or indifferent; and I believe the only persons who then thought of exporting largely, were MESSRS. COPE and Co., of Amritsar, now it is said that people are going about from village to village purchasing every seer they can procure, at prices not heretofore thought of. Every effort was made by District Officers, to whom a circular was issued for the purpose early in the sowing season, to rouse the agriculturists to a sense of the importance of the crisis; but it would appear not to have been until advices from Bombay and Kárachí worked conviction on the minds of the trading classes, that it began to be apprehended, too late to have much effect on the sowings of the present season, insomuch that in many districts, it will be seen, the area sown has actually fallen off since last year, owing mainly to the continuousness of the rains when they first set in.

"Still there has been, as above stated, some increase, and it is estimated that 6,02,466 maunds will be produced at the least; if the season prove as favorable as it promises at present to be. Of this quantity District Officers assume that not more than 1¼ lakhs of maunds (ten millions of lbs.) will be available for export, but I feel pretty sure myself that four times this amount will be exported during the current year, if the same high prices continue, and the means of transport be available. Even at the end of May last, after the close of the year, MR. COPE assured me that at least 10,000 maunds had been purchased for export within one week, in the vicinity of Amritsar; and since then further purchases have been constantly going on, showing how much more may be forthcoming on an emergency, than is ordinarily supposed. In the same letter, that gentleman added: 'The export of cotton will add about 3 lakhs to agricultural returns in these parts, and if it continue, the result will be much larger:' an estimate which I am by no means inclined to regard as excessive.

"While, however, there is every reason to believe that imported varieties of cotton will prove greatly superior to the ordinary indigenous varieties, there can be no doubt, that very much might be done to improve the produce of our existing species, and of the crops ordinarily raised by our cultivators, by greater care in picking, by better selection of seed reserved for sowing, and by adopting all such arrangements as are found to render the fibre better adapted to the Europe markets, and now that machinery is being adapted by some of the Manchester spinners to suit it for working up Indian cotton, this has become a matter of greater importance than ever. I understand that the best Indian cotton now sells in England at 6½ pence per lb., and could some of our European capitalists, connected with the cotton trade be induced, after the example set by the Belfast Association in regard to Flax, to send out agents to this country capable of instructing the people, and authorized to give prices varying with the excellence and cleanness of the cotton produced, two or three years would see a vast change effected. I subjoin three extracts relating to the cotton raised by MR. BERKELEY, which will be read with interest.

"'In last report, I expressed the opinion that the Punjab could not compete, as a cotton producing country, with portions of the Bombay Presidency and of Haidarábád and Nagpúr; which have long been distinguished as supplying the very best descriptions of cotton; and, although I still believe this to be true, supposing the demand to be limited, yet with the enormous demand now existing, it is clearly the interest and the duty of every portion of the Empire, in which cotton is grown, to do its utmost towards swelling the supply; and from what has been said above, it may be assured with certainty that we know as yet but little of the improvements which skill and capital may effect even here. The accompanying return gives the average produce of cotton fibre per acre in the Punjab, at about 88 lbs., but I believe this to be below the mark, in anything like a tolerable year. The Hissar return gives 156 lbs., and MR. COPE informs me that his enquiries lead him to believe that 150 lbs. is a fair average about Amritsar: 180 or 200 lbs. being considered a good crop; and as much as 300 lbs. being gathered in exceptionally favorable years.'"

I shall reserve all further remarks on individual experiments in cotton growing for detail in connections with the specimens in the sequel, by which they are illustrated.

The pressure on the cotton resources of India, during the last few years, no doubt creates a tendency to forming exaggerated notions of the capabilites of a province for the production of this crop, we must be on our guard against hoping too much; that sanguine expectation, while overlooking difficulties and obstacles, grasps at a golden future, too often

results in a disappointment, which leads to an utter despair of success, as false in itself as the unlimited expectation was. Even though the Punjab should never become a country whose staple produce is cotton, yet considering the area under actual cultivation, and the confirmed habit of the people in sowing this crop, every exertion, both to improve what we have and introduce what we have not, is in itself laudable, and sure to be productive of good. I shall conclude this sketch, by another extract from the valuable information contained in the "Gazette" already quoted. It shows well what are the prospects of cotton cultivation, and what difficulties are in the way.

"There cannot well be a shadow of doubt in the minds of those who know India, where cotton is probably indigenous, that it is capable of producing this article of almost any degree of excellence, and to an amount fully sufficient to supply the whole of Europe; and all experiences tends, I think to show, that what is now required is not the instituting of small and insulated experiments, but the deputation to this country, by parties interested, of men of skill and capital, able to direct the people as to the best mode of cultivating and preparing cotton, and ready to purchase on the spot, at remunerative prices, all that may be produced, suited to their purposes.

"While in England I endeavored to urge this on all occasions, but was surprized and discouraged by what appeared to me to be the prevailing want of enterprise, in regard to any new and uncertain undertaking in India; and even in Bombay I was usually told by the merchants, that their business was to purchase cotton when offered, not to look after its production.

"I have no hesitation, however, in stating my conviction, that the Punjab can never compete with other parts of India as a cotton exporting country, notwithstanding its great advantages in the matter of water carriage.

"The basaltic soils of Central and Western India, and perhaps some parts further South, are the parts to which England must look, viz., Gujrát and Berar, primarily, and after them the Nurbudda territory, yielding what is commonly termed, Bhawurgurh cotton; and Bundelkhund, large portions of the very best portions of which will be shortly opened up, and in part have already been opened up by the railroads to Baroda, Nagpoor and Jubbulpoor.

"I was assured many years ago, by MR. TERRY, the most practical and skilled of the Americans formerly employed experimentally by Government, that the plant yielding what is known in the market as Omraote cotton, and which probably does not differ from that of Gujrát, is a distinct variety from that of other parts of India, having three lobes only in the capsule, while the latter has four, and that he considered that cotton, if well prepared, equal to any American cotton for the great bulk of the manufactures of England.

"Government were at that time about to abandon the experiment, and he assured me, that if any capitalist would take him by the hand, he would undertake to produce cotton to any extent, and of excellent quality for the English market. But Government failing him, no one took him up, and nothing permanent resulted from the costly efforts which Government had made."

The collection consisted of the following kinds:—

1732.—Cotton (ordinary native).

Exhibited without specification of any particular species or origin as to seed or cultivation. When cleaned from the seed is called "rui" and "pambah;" the separated seed, "banaula;" when uncleaned, "kapás." In Házárá the plant is called "bár."

In the Muzaffargarh district the native name of cotton plants are thus given:—

The plant (Punjabí and Sindhí)—wanwár.

The raw cotton, uncleaned—kapás, phúttí.

The cleaned cotton—kapás and rui.

Seed separate (Punjabí, banaula)—pévé and kachra.

The unopened cotton pod—dódah.

The open pod—gógra.

The Samples were from—

(4715-16) Delhi, cleaned and uncleaned, and a sample in the pod (4718).

In this district it is noted that 5 maunds of cotton with seed, and 65 seers cleaned, is the average yield per acre.

(4721) Gurgaon (Firozpúr).

(4723) Rohtak.

(4729-30) Ambálah (cleaned and uncleaned).

(4735) Ludhiana (AMIR SINGH, Chaudrí).

(4737) Bhaji of Simla.

(4739-40) Mahlog of ditto (cleaned and uncleaned).

(4742) Sirmúr of ditto.

(4746) Balsán of ditto.

(4815-16) Scalkot (Bhadáwala), cleaned and uncleaned. Value, 20 and 28 rupees per maund. MUHAMAD KHAN.

(4878-82) Lahore Museum series. Cotton from Jhang, Leia and Lahore.

(4892) Gujranwalla.

(4899) Rawalpindi, and the seed (4900).

(4902) Gújrat.

(4916) Jhilam.

(4922) Shahpúr (Khusáb).

(4935) Gugaíra.
(4950) Dera Ismaíl Khán.
(4951-60) Dera Gházi Khán (a series).
Cotton from all parts of the district at prices varying from 1 seer 12 chitaks per rupee to 2 chitaks, from Dera Gházi Khán, Dájal, Chotí, Rájanpúr, and Sangar.
(4965) Peshawur.
(4971) Kapúrthalla.
(4975-76) Kashmír (Srínagar), (two samples).
(4980) Faridkot.
(4981) Nabha.
(4984-85) Pattiala (cleaned and uncleaned).
(4989) Malerkotla.
(4970) Hazara (Manserah), (cleaned and uncleaned.
(4780) Kangra (Haripúr).
(4791) Kúlú.
(4793-97) Hushyarpúr (two samples of cleaned and uncleaned).

1733.—Cotton grown from imported American seed (New Orleans).

(4717) Delhi.
(4719) is a sample of the same in pod. LALLA CHUNNA MAL.
(4725) Rohtak. LIEUT.-COL. VOYLE.
(4762) Jálandhar, grown by Zemindars. A note from the district gives the produce of cotton with the seed on irrigated land at 15 maunds per acre.
(4763) Jálandhar, grown for Government. DEPUTY COMMISSIONER.

1734.—Sealkot series.

(4811) American cotton, uncleaned. Value, Rs. 25 a maund. JASWANT SINGH.
(4813) American cotton, cleaned. BUDH SINGH.

1735.—Lahore series (Lahore Museum).

(4879) Cotton grown from American seed at Dera Gházi Khán.
(4880) Ditto Gujrát.
(4883) Ditto at Kasúr tahsil, Lahore district (1863).
(4884) Ditto, first quality at Sanda, near Lahore. CHAUDRI IMAM BAKSH (1863).
(4893) American cotton. Gujranwalla.
(4904) American cotton. Gujrát.
(4923) American cotton. Shahpúr. DR. HENDERSON.
(4946) American cotton. Government garden, Muzaffargarh. W. M. COLDSTREAM, ESQ.
With reference to the Shahpúr sample, I append a communication by the exhibitor, showing the very remarkable fact that American cotton has been known for years in Shahpúr.

"I am just sending to the Society 20 seers of green-seeded New Orleans cotton, acclimatised at Shahpúr for one year; also 20 seers of white-seeded Mexican which has been grown here for about eight years, and which last year yielded at the rate of eight maunds of seed cotton per beegah when sown in rows 4 feet apart. I also send 20 seers of green-seeded New Orleans cotton, which has been grown for at least 50 years in this district, I can get no information as to when or by whom it was introduced, the Lumberdars say it was grown by their grandfathers before them. I do not think it has degenerated perceptibly. I send a few seers also of acclimatised Egyptian seed. This cotton yields pods all the cold weather, but only in very small quantity at a time. I find that the total yield is rather more than New Orleans, but the Zemindars here allow cattle to destroy it as soon as the season for collecting country cotton is over.

"We have two kinds of hybrid cotton, a few seeds of which I can spare if any one takes an interest in it. Next year I hope to have several maunds of it and of several varieties. Should you want any more cotton seeds I shall be happy to send to any applicants all I have over. I have tried exotic cotton in various ways, and I find that the best way of sowing it, is to make trenches 1 foot wide by 6 inches deep at 4 feet 6 inches apart, put a good quantity of manure in these trenches and sow the seeds four together, at intervals of 3 feet. I have tried rows 8 feet apart, and as near as 3 feet. Even at 8 feet the rows of plants touch, and at 3 feet they form a perfect thicket. I think that between 5 and 6 feet will give the largest yield of cotton per beegah. By sowing in trenches there is a very great saving of water for irrigation. As the foreign cotton lasts for several years, I have tried planting young sheshums along the rows; these will get water for one or two seasons, and when the field has ceased to yield cotton there will be a fine young plantation left. In this way I think good timber might be raised in very large quantity at very little cost where there is much waste land suitable for cotton cultivation, each field being given up to the trees after three years, and new ground brought under cultivation.

1736.—Cotton from acclimatised American seed.

Samples from—
(4720) Delhi. LALLA CHANNA MALL.
(4905) Gujrát.
(4917) Jhilam. Pind Dadan Khán. From Agri-Horticultural Society's seed.

1737.—Egyptian cotton.

The peculiarlity of this cotton is, that in many loca-

lities it grows luxuriantly but never produces a flower or a boll of cotton : in the Agri-Hort. Society's Gardens, at Lahore, the seed plants, or rather trees, of Egyptian cotton, which have never borne a flower yet, are nearly 20 feet high, and the stem thick in proportion.

(4812) Sealkot, and (4810) uncleaned. Value, Rs. 25 a maund. MR. J. WIGHTMAN.

(4814) Sealkot. Value, Rs. 33 a maund. BUDH SINGH.

(4903) Gujrát.

1738.—[4726]. Nankin cotton. Rohtak. LIEUT.-COL. VOYLE.

This is a cotton having naturally a yellowish red or tawny tint : it is very little grown in the Punjab.

1739.—[4925]. Mexican cotton. Shahpúr. DR. HENDERSON.

The lengths of staple and values of Punjabí cotton are thus given in the table prepared by the Jury for Cotton in the International Exhibition of 1862. The samples were those produced by the Central Committee at Lahore.*

District.	Length of Staple in part of an inch				Value per lb.	Remarks.
	Maximum.	Minimum.	Mean.			
	Decimal fractions.			In vulgar fractions.		
Jhang district, 1st quality,..	·95	·65	·80	4-5ths	6½ to 8	Strong, short, and clean.
Jhang district, 2nd quality,	·80	·50	·65	2-3rds	6¾ to 9	Strong, short, and clean.
Ambálah, ...	·90	·70	·80	4-5ths	8	Chopped to bits in ginning.
Hushyarpúr, ...	1·00	·70	·85	7-8ths	7½ to 9	Shell ; short ; strong ; badly ginned.
Multán, ...	·90	·60	·75	3-4ths	8	Very weak, but of good color.
Leia, ...	·90	·70	·80	4-5ths	8 to 8¼	White ; clean.
Messrs. Smith, Fleming and Co., Punjab cotton, ..	1·20	·90	1·05	1	8 to 8¾	Very weak, but of good color.

As a sort of appendix to this class, I extract the following :—

Memo. on cultivation of acclimatised exotic cotton at Bakkar, in the Dera Ismail Khán district, which is curious from the locality, and interesting from the accuracy and completeness of the observation of results attained.†

"About the middle of April 1864, I received a small supply of acclimatised Egyptian and Mexican cotton seed, from the Secretary to the Punjab Agri-Horticultural Society, and at the same time I received from DR. HENDERSON of Shahpúr, a packet of acclimatised cotton seed of the following kinds, viz.:—

"1. Egyptian ; 2, Nankin (dust colored seed) ; 3, New Orleans (black seed) ; 4 ; New Orleans (green seed); 5, Mexican (white seed) ; and Sea Island.

"I divided each kind into two portions—one portion I had sown in the Government garden (Dilkhushá) in the 'kachí,' and the other portion in the land attached to the kutcherry in the 'thal.'

"The seed was sown, in accordance with directions I received from DR. HENDERSON, viz., in trenches 1½ feet wide, 9 inches deep, and 5 feet apart. The trenches were filled up to within 2 or 3 inches of the surface with good manure, which was well dug in ; 6 or 8 seeds were then sown, at intervals of 2 feet. The seed was all sown by the 26th or 27th of April.

"I mentioned above, that one portion of the seed was sown in the Dilkhushá garden in the 'kachí,' and the other portion in land in the 'thal.'

* DR. JAMESON contributed the following samples of cotton from acclimatised seed grown for ten years in the Botanical Gardens at Saharunpúr.

1. New Orleans cotton.
2. Upland Georgian ditto.
3, 4. The same, with their seeds.
5. Yellow Shanghai or Nankin cotton.
6. Egyptian cotton.
7, 8. The same with their seeds.

† The memo is BY LIEUT. HARE, Assistant Commissioner.

The 'Dilkhushá' is a large garden made by the grandfather of the present Nawab of Dera. It is surrounded by a bund built to keep out the inundation, which sweeps over the 'kachí' in July and August; on either side of this bund are rows of splendid shísham trees, and numerous date trees. There are also numbers of shísham trees inside the garden, consequently the cotton plants did not get as much light and air as they required.

The soil is good, and the situation being low, there is always a good deal of moisture in it. During the inundation, the percolation of water is great, and the growth of all plants is rapid.

"The kutcherry at Bakkar, is built on the sandy upland, known as the 'thal.' The land surrounding the house, was brought under cultivation some 8 years ago, by the Nawab, who sank a well in it, but owing to the poverty of the man who was in possession from the commencement of British rule until 1863, when the estate was purchased by Government, only a small portion of the original estate had been cultivated for some years past.

"Some of the seed had therefore to be sown in land, that had lain waste for many years.

"As the soil of the 'thal' consists almost entirely of sand, no crops can be raised without well irrigation and heavy manuring; by adopting DR. HENDERSON'S plan of sowing the cotton in trenches, there was a great saving of manure and water.

"The plants grew very rapidly in the Dilkhushá, especially during the inundation, their growth was somewhat checked, by continually breaking off the top shoots.

"The growth was not so rapid in the 'thal,' but I was advised by natives, to adopt the plan of breaking off the top shoots, and I observed, that where this was done, the plants yielded much finer pods, although the number was somewhat diminished.

"With the exception of a few plants which were attacked by the 'telí' blight, the plants in the garden in the 'kachí' were perfectly healthy.

"In the 'thal' the plants were extremely healthy, and of those grown in soil that had lately been under cultivation, I did not lose one; but in the land brought under cultivation for the first time, for some years, several plants were killed, by the scorching wind and drifting sand. I had not sufficient bullocks to work the well; and directly a plant was injured by the wind, it was eaten by white ants, which abound here. I eventually adopted the plan of putting up a screen of date branches to protect the plants from the burning wind.

"The plants commenced flowering in August. I was absent from Bakkar during September; but on my return at the commencement of October, I found the plants a mass of pods and flowers, many of the plants were so laden with pods, that they were completely weighed down. I counted 241 flowers and pods on one plant (New Orleans) growing in the 'thal,' and 221 on another plant of the same kind growing in the 'kachí.'

"I measured the size of the pods of each description of cotton, and counted the number of pods on several plants. When the pods ripened, I picked and weighed several of each kind of cotton.

"The picking commenced about the middle of October, and continued up to the middle of January. The cotton of each description was picked separately and put in large sacks made of matting, under the superintendence of a munshi.

"At each picking 3 or 4 pods were set aside and weighed by the native doctor, who kept a register. I was unable to weigh them myself, after the first time, as I had to go into camp, but I think the weighing was carefully done.

"I append a statement showing the height of the plants, weight of cotton, &c., but I must here explain that columns 7 and 8 do not give the average weight of the pods on any particular tree, but merely the average weight of each kind of cotton, throughout the pickings, from October to December. It will be seen that the acclimatised cotton pods yielded upwards of $\frac{1}{3}$ wool, and $\frac{2}{3}$ seed, whereas country cotton only yields $\frac{1}{4}$ wool to $\frac{3}{4}$ seed, the pods of the latter being about $\frac{1}{3}$ the size of the former.

"It will be seen from the statement that the Mexican cotton succeeded best, both in the 'kachí,' and in the 'thal.' The pods of this plant were remarkably fine.

"The green seed New Orleans cotton ranks next, for, although the average weight of cotton in each boll of this description, 16 grains, while the New Zealand yielded 17½ grains, it will be seen that the number of pods on the former, was from 45 to 50, whereas the latter only had 40.

"Black seeded New Orleans comes next on the list and then Nankin. These two descriptions, together with the New Zealand cotton, were, owing to the want of space, planted in a part of the garden, very much shaded by trees, and the plants in consequence shot up, and spread so rapidly that they did not get sufficient air and there was so much wood and leaf that the plants did not yield as much cotton as they would have done in a better situation.

"I consider the Egyptian cotton was a failure, the pods were few in number, and small, and did not begin to ripen till near the end of October; the yield was very small, as the cold weather came on before the pods were ripe, the result might have been more successful if the seed had been sown earlier, but the

tendency of this kind of cotton plant is to run to wood and leaves.

"I consider that the Mexican, and green seeded New Orleans cotton, are best adapted to this part of the country. These plants had a greater number and finer pods, than any other kind. The cotton appeared very good, and the fibre long.

Where grown.	Description of cotton.	Description of soil grown in.	Average height of plant.	Average size of pod before bursting.	Average number of pods on each plant.	Average weight of cotton wool in each pot.	Average weight of seed.	Weight of cotton in largest pod.	REMARKS.
In the Dilkhushá garden in the kachi.	1. Egyptian.	Rather poor, situation airy.	8 to 9	$3\frac{4}{8}$ in. circumference,	18	$3\frac{1}{4}$ grains	34	18	The pods of this ripen later than the other description; and the yield of cotton is very small.
	2. Nankin dust colored seed.	Good, but too much shaded.	5	$4\frac{8}{10}$	20	$14\frac{5}{8}$	$34\frac{1}{2}$	21	The cotton of this plant appears very good.
	3. New Orleans black seed.	Same as No. 2.	5	$3\frac{9}{10}$	25	$15\frac{1}{4}$	$35\frac{3}{8}$	21	..
	4. New Orleans green seed.	Soil inferior to No. 3, but situation better as regards light and air.	4	$4\frac{1}{10}$	45 to 60	16	40	21	220 pods and flowers were counted on one plant, one pod $4\frac{1}{10}$ inches in circumference.
	5. Mexican white seed.	Exactly same as No. 4.	4	$4\frac{1}{8}$	45 to 55	$18\frac{2}{5}$	$44\frac{1}{10}$	23	Some of the bolls of this description were very large.
	6. New Zealand.	Rich soil near well, but much too shaded.	6	$4\frac{1}{10}$	40	$17\frac{1}{2}$	$36\frac{7}{8}$	21	This cotton appears exceedingly fine.
In kutchery compound in the thal.	1. Egyptian.	Very sandy,	6	..	20	$12\frac{1}{8}$	$33\frac{3}{4}$	18	..
	2. Nankin dust colored seed.	"	$3\frac{1}{2}$ to 4	..	..	$14\frac{3}{4}$	$36\frac{1}{8}$	18	..
	3. New Orleans black seed.	"	"	..	..	$15\frac{1}{4}$	$35\frac{3}{8}$	21	..
	4 New Orleans green seed.	"	"	..	..	$15\frac{10}{11}$	$39\frac{10}{11}$	21	241 pods and flowers were counted on one plant.
	5. Mexican white seed,	"	"	..	..	$18\frac{2}{5}$	$44\frac{1}{10}$	22	...
	6. New Zealand.	"	$3\frac{1}{2}$	..	..	$17\frac{1}{2}$	$36\frac{3}{7}$	21	Very few plants of this kind survived.*

1740.—[ ]. Flax *(Linum usitatissimum). Vern.*—Alsi; katán (Arabic); keún (Kashmírí): tisí.

It would be rash to assert that flax is indigenous to India, though there can be but little doubt that its origin is Oriental. It is mentioned in the Scripture, both in Exodus and in Joshua; in the former

* I did not measure the size of the pods, nor count their number in the thal.

book it is described as one of the crops, in the account of the plague of hail. There are very ancient paintings too in Egypt, in which flax figures; and lastly, linen cloth was the material used for burying cloths.

In India, however, the flax has been usually cultivated for its seed, and not for the fibre; the prevalence of cotton as the staple fabric may account for this.

"The Indian plant," writes DR. ROYLE,* "called *alsi* and *tesi*, may be considered a variety which has acquired certain characters from the peculiarities of soil, of climate, and of long and peculiar culture. It is always short, probably not more than 18 inches in height, much branched, loaded with bolls, which are filled with large ovoid plump seed. That this retains its character even in other situations appears from a fact, of which I have been informed by MR. MACADAM, the able Secretary of the Society for the Promotion of the growth of Flax in Ireland. The Society having imported some seed for experiment from India, found that the plant did not grow beyond fourteen or eighteen inches. But that it is also ready to change its habitat is evident from the results of experiments in India. I have also been informed that in a recent experiment made by MR. BURN, in Sindh, with thick sowing and irrigation, it grew at once to upwards of two feet; I have no doubt that with a repetition of the process of thick sowing for a few times the Indian seed would produce plants with tall, straight, and little branched stems, each with but comparatively few bolls and seeds."

It is impossible in a sketch like this to delineate the progress of flax in India: suffice it to say, that in 1839 a company was established to promote the growth of flax in India, and MR. DENEEF, a Belgian farmer, came out, prizes were offered, and every encouragement shown. Some of the flax produced, was valued at £66 a ton; some at £30 and £45.

The experiments were made at Shahábád, Bardwán and Monghyr, and best of these at Saháranpúr and Jubulpúr. The experiments, however, were mostly on a small scale, and the success on the whole was not brilliant; the Bengal fibres were not at all equal to European.

When the subject of flax cultivation in the Punjab was started, it was observed, that at Lahore and a few other places, some use of the fibre was made for rope and twine, in making charpoys or bedsteads; and still more so in northern parts, as some of the seed of flax obtained in Bukhára proved to be when seen in England, the common flax.†

* ROYLE'S Fibrous Plants, page 143.
† "Fibrous Plants," 193.

In most places the fibre was always burnt, the crop being grown from seed, 3 maunds of which to a begah of land was thought a good crop. The seed sold for from 18 to 30 seers per rupee, and in Kangra up to 100 seers per rupee!

The crop was often cultivated round the edges of fields, or mixed with other crops; it was seldom irrigated, though often planted in inundated khádir lands. In 1853, the Agri-Horticultural Society began their experiments with seed from Saháranpúr: and even at that early stage, the produce of the fibre far exceeded that of previous trials in Bengal and Behar. Then followed proposed prizes for flax cultivation—equitable terms on which flax crops of cultivators would be bought up; and in fact a general system was started by the Society, and warmly seconded by Government, such as was best calculated to introduce the cultivation of flax as a fibre, into the Punjab. The Society's plans are given in detail at page 195 of DR. ROYLE'S "Fibrous Plants." Excellent instructions were printed and circulated by the Society in 1854, copies of which are still to be had.

In short, there seemed no question that flax would succeed better in the Punjab than in Bengal. The native flax at Indaura (Kangra valley) was noted already as valuable. In 1858, a quantity of it was sent home, it was considered to be the finest specimen sent from the Punjab, and was valued at the high price of £55 to £60 a ton, and actually sold at £54 10*s*.! "If," wrote MESSRS KAIN AND CO., Dundee, "flax such as COL. BURNETT sent home could be put on board at Kárachi for £26 a ton, it would leave to both importer and exporter a handsome profit."

The first question to be disposed of was the fact that the native seed, grown as it was by native farmers, could not yield fibre: was it possible to improve the native seed by better cultivation; or was it best to import seed? Practice up to the present moment has decided in favor of the latter; no doubt, the native flax is capable of improvement, but the ease of obtaining first rate seed from Europe which acclimatizes and lasts without renewing several years, has practically decided in favor of importation. It is interesting to remark how this was at once suggested by the Secretary to the Royal Flax Society of Ireland, in his letter published by the Agri.-Hort. Society in 1854, from which I quote. MR. MACADAM wrote—

"The quality of flax fibre produced in warm climates is necessarily very coarse, and does not, in the least, interfere with what is grown in Ireland, while it is very largely employed by manufacturer's for a certain class of fabrics. It would be much more satisfactory to obtain it from a British colony, than to be dependent, as hitherto, chiefly on Russia for the supply.

"In consequence, not merely of the war, but of the demand of coarse flax having of late years exceeded the supply, manufacturers, both here and at Dundee, are very anxious to obtain flax from India. The Belfast and Dundee Chambers of Commerce have forwarded memorials to Government on the subject, and I have had some correspondence with DR. J. FORBES ROYLE, of the India House, on the subject. He appears to think that very little fibre can be obtained from the flax plant of India, which he states to grow very short, and to have extremely little fibrous matter round the stem; but I have all along thought, that if a fair quality of coarse fibre can be produced in the valley of the Nile, the export from Egypt being 3,000 to 4,000 tons annually, there is quite as good a chance in the valley of the Indus; and I had already pointed out to DR. ROYLE, the Punjab, as one of the best points for making the experiment.

"I am inclined to think that one cause of Indian flax being reported on so badly is, that the proper kind of seed is not employed, and I would strongly recommend that Riga seed should be procured here for future trials, as the natives have hitherto employed only the seed of the country, which has quite a different character from the Riga."

Of late years the Belfast Indian Flax Company have, by their agency at Sealkot, completely established the ascendancy of imported and acclimatised seed, and though there have been failures on account of the deterioration of batches of seed during its transport from Europe, the experiment has been successful. We must not be surprised at losses, perhaps heavy losses and disappointments at starting: hardly any great enterprise that has now made the fortunes of hundreds has ever come into existence or completed its growth without many reverses; nor must we expect this to succeed all at once without a shadow of disappointment passing over.

The operations of the Society at Sealkot have already been viewed with the warmest interest by Government, who have rewarded by prizes and khilats the successful cultivation by zemindars, in a manner which we can only wish to see extended to other departments of agriculture.

The advances made at Sealkot, year by year, are on record, and present some of the most interesting and economically valuable records it would be possible to collect.

To show how satisfactory the foundations of the undertaking was when the worst calamity, the failure of its seed happened, I extract paragraph 129 of the Revenue Report for 1861-62.

"The sanguine hopes expressed in my last report, in regard to the operations of the Belfast Indian Flax Association at Sealkot, were shortly afterwards seriously damped by the discovery, that the whole of the seed sent out by that body, had been so entirely damaged on the way, that no portion of it would germinate: an announcement which produced so depressing an effect, both on their agent here, and on the Committee at home, that it at one time appeared doubtful if they would have the resolution to persevere in the undertaking. On the spirited representation, however, of DR. FORBES WATSON of the India office, who had very opportunely received a specimen of last year's Sealkot flax, valued by the Committee themselves at between 60 and £70 per ton, the Right Honorable the Secretary of State for India was pleased to authorize an advance to the Association of £1,000 per annum for 2 years; on their engaging to carry on their operations for 3 years at all events; which most liberal offer was thankfully accepted, and the progress of the undertaking at once ensured.

"Very great disappointment was evinced not only by the agent, MR. WIGHTMAN, but by the zemindars themselves, on finding that the seed which they had confidently anticipated would be distributed to them in September, had utterly failed.

"All the available acclimatised seed of the previous season was however distributed—the zemindars contending with each other for shares—and the season having proved favorable, the results have been most encouraging, as shown in the subjoined extracts* from a letter of the Deputy Commissioner of Sealkot, dated 24th April last. MR. WIGHTMAN, was fortunately at Kárachí when the flax of the season, manufactured and dispatched by him, arrived there, so that he was able himself to see it pressed and shipped, so that I am in hopes the results of the season, though

* With regard to the prospects of this season, MR. WIGHTMAN'S report is most promising. 200 maunds of flax and 150 of seed, all English, have already been taken in, which exceeds the out-turn of the whole of last year's crop. The English flax is much superior in quality to anything produced last year; and, indeed to anything MR. WIGHTMAN thought possible to produce here. But the native flax is very inferior to last year, and little of it will be fit for export.

The price given for three maunds of straw is Rs. 3, and one maund of seed Rs. 5. The seed advanced being first deducted in kind. The market price of native seed is about Rs. 1-4 per maund. The value of the product of an acre in such villages as Doobarjee has been from 42 to 45; the average of an acre of wheat even at present high prices is from 25 to 30. In ordinary years the difference will be still more striking, several growers and those not first rate ones, have informed the Deputy Commissioner that even at present prices, flax is more profitable than wheat.

"MR. WIGHTMAN states that his prices are such as pay him.

"Under these circumstances I think the prospects of the movement may be considered most cheering."

small, may prove very encouraging to the Committee at home.

"Recently a very large supply of Riga seed (I believe 15 or 20 tons) sent out by the Association was received by steamer at Bombay. Their agent, MR. WIGHTMAN had proceeded thither from Sealkot to receive it, and the most energetic action was taken by His Excellency SIR BARTLE FRERE, Governor of Bombay, for securing its immediate transfer on reaching the harbour to the Kárachí steamer.

"It accordingly reached Kárachí without delay, was there examined and found to be in good order, reached Múltán sometime ago by steamer, and is now on its way laden on camels to Sealkot. Another ton of seed, ordered on account of Government, has also reached Calcutta, and may be expected here shortly; when it is proposed to distribute it to cultivators willing to cultivate, in the Lahore, Gujranwalla and Amritsar districts, so that the spirited undertaking of the Belfast Association could hardly give better promise of success than it does at the present time. A distribution of prizes for the cultivation of flax has been authorized to take place during the present month, and I have no doubt that under the auspices of MR. PRINSEP, who has from the first taken a hearty interest in the experiment, it will have the best effect."

The more recent statistics of the Company's operations at Sealkot appear in the following extract:—

"The prospects of the Company may be briefly stated as follows:—

"Last year, 1861-62, 80 maunds of prepared flax were sent home. The quality is supposed by MR. WIGHTMAN to be equal to any grown in Ireland.

"In the present year, 1862-63, 200 acres were successfully cultivated, of which the out-turn (not including seed given and its equivalent received) was as follows:—

	Mds.	Price paid.
"Flax straw, ... Rs.	2,533	844
Seed, the produce of acclimatised seed, ... Rs.	490	1,960
Ditto, imported ditto, „	234	1,404
Total, „	3,257	4,208

giving an average of Rs. 22 per acre. Rs. 40 would have been the average, had the seed been good. The average yield of wheat per acre has been about Rs. 18.

"The quantity is the same as the previous year, as regards produce of acclimatised seed. The produce of the imported seed is superior to that of acclimatized. The out-turn will probably be 8 tons = 216 maunds. Only 30 maunds of native straw have been taken out good, as native straw is only two feet long, and English three and more; and the labor required for a bundle of the same thickness being the same, there is of course, a loss in labor of one-third, the straw is also more woody.

"In 1863, 291 acres were under flax cultivation in Sealkot, and its yield was 34½ tons of seed, and 178 tons of fibre."

The whole process of flax cultivation has been so fully described, that it seems superfluous to make any allusion to it. The main points requiring attention appear to be not to sow too late, as otherwise the growth instead of being progressive, steady and slow, such as insures a tall even firm plant, becomes by the heat of the later season, &c., rapid and hectic, and the value of the fibre is destroyed both as to length and quality.

The other point requiring attention is to gather the plant at the right time, the simplest method of judging being by observing the leaves falling off from the stalk; when the leaves have fallen off, up to a certain height, the stalk is ready, and this at a time when the seed also is not so ripe as to be shaken out of the pods.

The seed is generally now removed, by the process of rippling, done on or near the field, which simply consists in drawing the heads of a handful of the plant spread out like a fan, lightly over the pointed teeth of a large iron comb fixed upright, and teeth upwards, into a stout wooden beam. The fibre is then stacked in bundles, and then steeped. In some parts of Russia, the flax is dew-retted by exposure simply on the surface of the soil to dew and rain. When the watering process is done, the flax is very carefully lifted out, and spread on the soil for a certain time. The flax is lifted out of the water by men's hands and not by forks, which destroy the fibre. The length of time required for steeping is very various, according to circumstances. It is said to be a good method of testing the completion of the process, to take out a stalk of average thickness and break the *shove* or woody part at the centre in two places, 6 or 8 inches apart: if this detached piece of wood can now be drawn easily out downwards without hurting the fibre, and without any of the fibre adhering to it, the steeping has gone on long enough.

When sufficiently dry after SPREADING, the flax is LIFTED, and bound into small bundles. It should never be dried by fire, for this spoils the fibre and renders it weak and brittle. Improvements in steeping have been the subject of much enquiry. The idea of heating the water for steeping, occurred to some, and the application of steam to others. SCHENCK'S process and WATT'S process, which are embodiments of two principles, are the best known; both are treated of in detail in ROYLE'S Fibrous Plants.

The next thing to be done is to remove the woody bark, &c., from the fibre, called breaking. This

used to be done by hand, by twisting up a bundle of stalks as it passed through the hands, and then shaking off the bark fragments that were separated. The same was also effected by the *bott hammer*, a flat mallet, with its face cut into grooves, the handle to it being curved, and this being repeatedly struck on a quantity of fibre spread out on a board, first on one side and then on the other. But as the whole of the bark is never removed by this process, another is required, viz., *scutching*. An upright board has a horizontal slit in it, the slit being made at the edge of the board and narrow at the end: into this slit a handful of broken flax is inserted, and the right hand strikes the fibre in the slit, with a kind of wooden sword or trowel, 8 or ten inches broad; the flax is continually shifted about in the slit by the action of the left hand. The operation also used to be performed by passing the flax between 3 fluted metal cylinders, one of which is made to revolve, and carries the other two with it.

Since this time many improvements have been made in machinery. Fluted conical cylinders, whose distances from one another could be variously adjusted, were employed. Several manufacturers have now devised machines whereby the previous process of retting may be dispensed with.

The last process in preparing the fibre is that of smoothing, separating and arranging the fibres, by the process called *heckling*. This is effected by skilful manipulation over the points of a kind of comb.

The refuse is "tow" and this yields a packing material, but is still more valuable as being a very superior paper fibre.

The sample exhibited under the head of flax were as follows:—

1741. [4770]. Flax from Núrpúr, Kangra district.

Grown by the zemindars in pergunah Núrpúr for fibre as well as for seed, and largely exported into the Punjab.*

1742. [4799-4809]. Series illustrating the flax cultivation of the Belfast Company, under their agent, Mr. Wightman, at Sealkot.

Flax produced from imported seed. Ditto from seed acclimatised (the 2nd year). Ditto (3rd year). Value, 2 maunds per rupee.

Flax after steeping. Value, 1 maund per rupee.

Native ditto. Value, 3 maunds per rupee.

Flax (dark colored) scutched, &c. Flax (white) prepared differently. Value, from £50 to £100 per ton.

Tow. (The refuse from the heckling and scutching, useful for paper making). Value, 2 rupees per maund.

Seed, resulting from the 1st growing of imported seed.

Ditto, 2nd growing of. Value, 5 rupees per maund.

These seeds are larger and longer than native seeds; and have a greenish brown tone, instead of the red-brown or reddish tone of the native.

1743. [4830-35]. Lahore Museum series.

Indaura flax (Kangra district).

Flax grown at Lahore in the Agri-Horticultural Society's Garden.

Flax grown at village Sanda, near Lahore. Chaudri Imam Bakhsh.

1744. [4894]. Flax, Gujranwalla. Local Committee.

1745.—[ ]. Madár floss, the cotton of the pods of *Calotropis hamiltonii*.

This plant grows everywhere on waste dry situations where nothing else will grow. It flourishes actually on beds of simple sand, and it appears to require no water. Its broad leaves, its white and purple incised bell-shaped flower, may be seen all over India, though the prevalent species southward is *C. gigantea*, and that in Northern India is *C. hamiltonii* or *C. procera* still further north and up to Persia. Notwithstanding the barrenness of lands where it is usually found, it does not appear that richness of soil and fertility are prejudicial, and we hear of plants in Demarara, to the height of 12 or 18 feet, and in Mysore to a great size.*

The floss of the madár is found within the large crescent-shaped seed vessels, as soon as they are ripe; but the stalk of the madár plant itself affords a tough coarse fibre which makes ropes of surprising strength. In the Bombay Selections, No. XVII., it is mentioned that fishermen in Sindh use the fibre for ropes to their nets.

The floss of the Syrian dogbane, one of the *Asclepiadeæ*, has been made into fabrics both in France and Russia. And the jeté or bowstring fibre of the Rajmahal hills (which bore 248 lbs. when dry, and 343 lbs. when wetted, when hemp bore only 158 and 190 lbs.) is also produced by *Marsdenia tenacissima* of this family.

* Local Committee, Kangra.

* Madras Exhibition of 1859. Notes on Calotropis fibre and Silk, page 4.

The juice is used in tanning leather, and coagulated forms a white kind of gutta percha. A sample was contributed to the Exhibition of 1864 by DOCTOR. HUNTER from Madras. Ten average plants will yield enough juice to make 1 lb. of gutta percha. The juice is evaporated in a shallow dish, and when dry is worked up in hot water with a wooden kneader, as this process removes the acridity of the gum. It becomes soft in hot water, but is hard certainly in cold. The sample sent to the Exhibition in the winter was quite hard, having received the impression of a medal some time previous in Madras. It is soluble in turpentine.* No attempt has I believe been made to produce it in the Punjab. The roots are burnt, and the ashes of them extracted for a medicine for asthma, esteemed by native doctors.

The root and the bark of it powdered, as also the juice, are powerful alteratives, and are used in leprosy and other cutaneous disorders, and in elephantiasis.

The madár is also famous for yielding the "shakar-ul-ashar," or "Shakar taghár," a kind of manna.† The insect by whose piercing the exudation is formed, is called *gultigál*‡. This is very uncommon, however, and cannot be obtained in the bazars.

The madár is remarkable for containing a principle called *Mudarine*, which coagulates on being heated, but again liquifies when cold.†

Unlike other fibres, the madár needs no preparation, the silky yellowish floss has only to be collected free from dirt and packed. Experiments have been made with it by MESSRS. THRESHER and GLENNY, not however without great difficulty, on account of there being no machinery suited to it; the cotton machinery literally blew it away. This enterprizing firm, however, produced some articles of clothing, and some other articles, with madár and common cotton in equal parts, and a flannel from madár in one part, and wool two parts.

The great difficulty seems to be the price. In the Punjab, the collection was taken up with some interest in the district of Dera Ismaíl Khán; but it appears that the cost of carriage and collection is such that the floss is at present unremunerative at the selling price. The principal objection to it is the weakness of the fibre. It will probably in any case succeed better as a mixture. The Exhibition of 1864 contained fabrics from Dera Ismaíl Khán and Rawalpindi woven from madár, and also rugs made in the "turkey carpet," or pile fashion.

Floss or silk-cotton from the pods of the madár, was sent from—

(4836) Lahore (village Sanda).

Sample of twisted thread from ditto (Dera Ismaíl Khán produce), (4837).

(4898) Rawalpindi.

(4221) Shahpúr (thal tracts).

(4945) Jhang.

(4949) Dera Ismaíl Khán.

(4991) Maler Kotla.

There is a paper on the manufacture of cloth and paper from this substance in Vol. VII. of the Agri-Hort. Society of India's Journal.

1746.—[ ]. Fibre from the stalk of the madár.

A sample of the rope from the stem fibres of the madár was also sent from Lahore, by CHAUDRI IMAM BAKSH (4859).

This is a distinct substance from the former, and is much superior, being very strong, flexible, and yet lustrous and silk-like. It is obtained by cutting down the largest branches in October and November, or April or May: just when the plant ripens, or when it is growing to flower, is the best time. Steeping in water cannot be practised, as it damages the fibre: but the branches on being cut are allowed to lie awhile, and then are beaten and bruised all over, especially at the joints; and the bark *with* the fibre is peeled off: the fibre is picked off the inside of the bark *not* from the stem itself.

"The workmen," says CAPTAIN HOLLINGS, "bite though the centre of the bark, then hold the tissue of threads with one hand and separate the bark with the other." CAPTAIN HOLLINGS says, "the manufacture costs £100 a ton, and making thread of it £120, the expense being in separating the fibre, for which some improved process is much needed. Cordage and rope have been made of it, but with varied results as to strength. The Indus fishermen make lines for their nets with the fibre." Many more particulars as well as the methods of manufacture will be found in the 2nd Vol. of the work, under "Fibrous Manufactures:" and several papers of interest are to be found in the Agri-Hort. Soc. Journal, Vol. VIII., together with the opinions of skilled persons on the fibre.

As a textile fibre it was supposed to be well suited for finer fabrics; as a rope fibre it is found superior to hemp. DR. ROYLE says that in his experiments, when Petersburgh hemp broke at 160 lbs., and Bombay brown hemp bore 190 lbs., madár fibre also bore 190 lbs.

1747.—[4838]. Fibre of the lotus (*Nelumbium speciosum*), from village Jinjan, Lahore district. PANDIT RADAKISHN.

The sample consists of a set of little hanks of a

* ROYLE'S Fibrous Plants, 307.

† *See* also under Drugs for this plant.

‡ Himalayan Botany, 275.

soft yellowish white thread. The long stalks of the lotus are pulled up, and broken at one end, when the ends of the threads which are contained in the stalk appear; these are gently pulled out and wound off.

The principal use of the fibre is for the wicks of sacred lamps, in Hindú temples, but it is said by Hindú doctors that cloth woven of the fibre has medicinal virtues, and acts as a febrifuge.

1748.—Cotton from the *Bombax heptaphyllum.*

Another common product is the cotton from the sembul or cotton tree. It is only found somewhat sparsely distributed in the Punjab, and also in the lower hills of Kangra and Hushyarpúr.

The short-stapled whitish cotton is not producable in sufficient quantities to be made an article of trade, it is used to stuff pillows with.

Cotton from *Bombax heptaphyllum* was sent from
(4791) Kangra (foot of the Hills).
(4797-81) Hushyarpúr.
(4840) Lahore (CHAUDRI EMAM BAKSH).

The ripe fruit of the "palách" or "fálsch" (*Populus ciliata*) yields a short downy cotton that is not unlike this substance. I have seen paths in the hills, near Murree, in the month of August, strewed with this cotton falling from the trees like snow.

1749. Himalayan nettle fibre (*Urtica heterophylla*) (*Urticaceæ*). *Vern.*—Bichúa; allú; garain; chichrú.

This plant is of very wide distribution, being found in Assam and Burmah, in the Southern Concan, on the Malabar coast, and on the Neilgherries, and in the Northern Himalaya.

The plant is an annual, with erect, angular stems, marked with small white specks, in which are inserted stiff and acute bristles. The leaves, which are long and large, are covered with bristles and deeply serrated at the edges.

DR. ROXBURGH calls it "a ferocious-looking plant," and indeed its sting is very severe, but the pain of short duration.*

The fibre is long soft, white and silky, and would probably produce fabrics of a beautiful texture.

The common nettle of the Himalaya, is called "bichu,"† or "alú."

The plant abounds in the ravines and valleys during the rainy months, and forms one of the rankest weeds, rising to a height of 6 or 7 feet.

DR. CLEGHORN wrote to the Agri-Horticultural Society, Punjab:—

"The *Urtica heterophylla* (the species cultivated by MR. MCIVOR at Ootakamund) is plentiful in Simla, having followed man to the summit of Jako, attracted by moisture to an elevation unusual for any member of the family. It is found within the stations of Dalhousie and Dharmsalla, and at many intermediate points. The quantity is surprising, wherever the soil has become nitrogenous by the encamping of cattle; the growth at this season also is luxuriant in shady ravines near houses, where there is abundance of black mould, but the sting being virulent the plants are habitually cut down as a nuisance, both by private persons and Municipal Committees."

1750. Fibre of *Nussiessya hypoleuca* (*Bœhmeria salicifolia*). *Vern.* — Sihárú. Called chainchar and chainjli in Hazára.

Not yet recognized as a merchantable commodity.

The fibre is valued for net ropes, on account of its resisting the action of water. The fibre, it would appear, is prepared by the hill people without steeping. It is merely dried, and when brittle is beaten, and the fibre separates easily; the plant is cut in October.

But DR. ROYLE, quotes CAPT. RAINEY, when Political Agent at Sabáthú, who describes the process of preparation as more laborious.

The plant being cut is exposed one night in the open air. The stalk is then stripped of its leaves and dried in the sun; when dry, it is placed in a vessel with water and wood ashes, and boiled for 24 hours. After boiling the fibre is well washed in a stream.

The fibre is then sprinkled with flour of the grain "kodra" (*Paspalum scorbiculatum*), and left to dry, is then ready for spinning, &c.

The celebrated *Caloi* fibre of Sumatra is yielded by *Urtica tenacissima*, which is identical with *Bœhmeria nivea*. The rhea fibre of Assam, which is the

* The *Urtica crenulata* appears to be the worst stinger of the family. LESCHENAULT DE LA TOUR, says, "that in gathering a piece in the Botanic Gardens of Calcutta, one of the leaves lightly touched three fingers of the left hand. In about an hour the pain became severe, as if the finger was rubbed with a hot iron. There was no appearance, however, of swelling or inflammation. The pain soon spread along the arm as far as the armpit. He was than seized with a frequent sneezing and running at the nose, as if he had caught cold. He then experienced a contraction of the back of the jaws: the pain did not abate for 3 days, and was not wholly relieved till after 9 days had elapsed." LINDLEY, Veg. Kingdom, page 261. The stinging nettles are the *Urticas*, the stingless come under *Bœhmeria*.

† The name for a scorpion, probably given to this plant on account of its stinging powers. Fibrous Plants, 372.

same as the "Chú ma," or China grass, is the product of the same stingless nettle. The "ban" or wild rhea, is also yielded by a *Bœhmeria;* another and similar species (if it be not identical) is described under the name of "mesakhi:"* a gigantic nettle is described in Garhwal as growing to a height of 12 or 14 feet!

The species of fibre-yielding nettles are as follows:—

1. Rhía, Rámí, Caloi (Sumatra) Kankhúra (Rajpúr), China grass, *Bœhmeria nivea* (*Urtica tenacissima* of Roxburgh).
2. Sihárú (Kangra hills), Tulsiárí, Chainchal (*Nussiessya hypoleuca*), (*Bœhmeria salicifolia*).
3. Bon or jungle Rhea. *Bœhmeria sp———?* (Lípiah of Naipál).
4. Mesákhí. (*Bœhmeria sp———?*)
5. *Boehmeria lobata* (Ullah). Sold for hemp at Almora, and is common in Garhwal and Kamaon.
6. Púah fibre (*Bœhmeria frutescens*), (Naipál and Sikhim, and Garhwal). Besides these *Bœhmerias*, *B. macrostachya* and *Goglado* are found.

The other species are—*B. rotundifolia*, *B. pulcherrima* (changar), *B. argentea*, *B. dichtoma*, *B. moniliformis*, *B. trinervata*, *B. nervosa*, *B. macrophylla*.

7. Chorputta or Surat (E. of Bengal), *Urtica crenulata*.
8. Nílgirí and Himalaya nettle, Horoo Surat† Assam (*U. heterophylla*). Chichrú, bichúá, &c., of the Himálayas.
9. Jarkandálú, Kandálú and Kabra (probably *U. heterophylla*).
10. *Urtica virulenta* (Dera Dhún).
11. *Urtica parviflora* (Rohilcund), (Bichu, shishona).
12. *U. pentandra* and *heptandra*—Jephul jan.
13. *U. paniculata*.
14. *U. reticulata*—Salgárí.
15. *U. longispina*—Jalgára.
16. *U. filiformis*—Sínghar.
17. *U. atrofusca*.
18. *U. funicularis*.
19. *U. dolabriformis*.

In the Jammú hills a species of nettle is produced called "sadar."

The great length, pure white color, and fine texture of the nettle fibre, would seem to indicate success in the production of fabrics, for which the finer flax is used; and it would probably, like the China grass, exceed flax in delicacy and beauty.

The coarser varieties are likely to suit for ropes; as also the outer bark which makes a strong rope.

The wild rhea fibre, when worked into a five-inch rope did not break till a weight of 9 tons, or 21,025 lbs. was attached; and other experiments have shown its strength to be nearly three times that of Petersburg hemp.

Besides these fibres, some species are medicinal and edible.

The roots of *U. tuberosa* are boiled as an article of diet, and the leaves of *B. caudata* are esteemed in Brazil a remedy for hœmorrhoids.

U. nivea if salted will curdle milk like rennet.* There are other species also useful in medicine.

The samples of nettle fibre were:—

Simla States, under the name of "bichúá."
(4738) Bagal.
(4741) Mahlog.
(4744) Kotí.
(4748) Balsan.
(4750) Baghat.
(4752) Tiroch.
(4756) Karaiti.
(4757) Jubal.
(4760) Hills near Simla (MR. GEO. JEPHSON).

Kangra hills, from 5,000 to 9,000 feet, 4,765 on the outer range, called chichrú; kiñji (Hazára); sazankai (Pashtú); "the stinger."

It grows to a height of 8 or 10 feet in the rains, in places where sheep had been penned during the route across the ranges. The "gaddís" make coarse ropes of it. They strip off the bark when dry, it is called "garain" or "bichú."

(4821). Thick rope from the bark of do.

(4766) "Sihárú," foot of the hills, Kangra (*Bœhmeria salicifolia*) now *Nussiessya hypoleuca*.

1751.—*Onoseris lanuginosa*, kafi (Kangra);† kat katulla (Hazára, &c.); kasbal (Sutlej, &c).

There is another plant, yielding a fibre, or rather strips of a fibrous snow-white substance, which form the tomentum over the back of its leaves.

ROYLE says "it is called kapásí" (from "kapás," cotton), and that "it is used as tinder in the Himalaya:" also, "he adds, that a coarse kind of blanket, called 'karkí,' is said to be made of this substance by the hill people, north of Dera Dhún."

The following account of the *Onoseris* is from CAPTAIN HUDDLESTON'S Report.

The "kupassee," as it is called, from its leaf

* Journal Agri-Horticultural Society, VII., 215.

† ROYLE, also called "serpat" or "herpat" by the Bhootias; and "theng mah" (Chinese).

* LINDLEY'S Vegetable Kingdom.

† Fibrous Plants, 302. Nat. Order. *Asteracea compositæ*.

being similar to cotton, is, I believe, the tinder plant.*

* * * * * * *

It is a small plant with a broad leaf, which yields a fibre like cotton, and the white skin is stripped off the bark of the leaf. The leaves are plucked in July and August, one maund of which will give about a seer of "kupassee," which is torn off the leaves the day they are plucked, and given to a weaver for being made into a thread, from which small bags are made, the bags sell about 6 annas each, but will not bear wet, and the thread is very weak and rotten. It takes 4 or 5 men to collect the cotton for a maund of leaves, but it is not in very general use. The fibre also makes very good tinder. The plant is not collected for sale, but only by the natives for their own use.

II. FIBRES MAINLY VALUABLE FOR ROPE MAKING.

1752.—Hemp, *Cannabis sativa* (*Cannabis indica*). *Vern.*—Bhang; ganja; ganjika (Sans.); hinab (Arabic), (from this last are derived Greek κάνναβις; the Dutch hennep; and our "canvas;" French, chanvre," and "hemp."

It is remarkable that the three great staple fibres—cotton, flax, and hemp—should all be indigenous to Asiatic countries, if not to India itself.

The origin of this plant is indicated by its name, being of Asiatic origin, and giving rise to all other European names, the Sanscrit and Persian alone being different.

It is cultivated everywhere in India for its intoxicating leaves and gum resin, and grows up into the hilly regions of the middle and lower Himalaya.

Dr. Royle† says he has seen it 10 to 12 feet high at 6,000 and 7,000 feet. Notwithstanding its common destination of producing only bhang, the fibre has in some places been used, and a coarse cloth for grain bags, and even for personal wear, such cloth being called "bhangela," is made in the Himálaya, and a strong rope, called "sel." Shoes or knotted sandals are also made of hemp twine. (*See* Royle's Fibrous Plants, p. 327). Dr. Royle quotes Kirkpatrick's account of Naipal, and General Hardwicke, in support of this, and he adds he himself obtained rope and cloth in Kashmír.

The use of the fibre was perfectly well known also to the ancients.

In the fourth book of Herodotus (c. 74-75), the author referring to the manner and customs of the Scythians, says, "they have a sort of hemp growing in this country very like flax, except in thickness and height, in this respect the hemp is far superior; it grows both spontaneously and from cultivation; and from it the Thracians make garments very like linen, nor would any one who is not well skilled in such matters distinguish whether they are made of flax or hemp, but a person who has never seen this hemp would think the garment was made of flax." The plant is called by Herodotus "cannabis," the same word which we now use, and from which the English word canvas is derived.

To the present day it grows in Northern Russia and Siberia, Tauria, the Caucasus, and Persia, and is found over the whole north of Europe.

We next hear of it in Pliny, who describes the hemp-plant as being well known to the Romans, who manufactured a kind of cordage from it. This author has minutely described in the 19th book of his Natural History, the mode of cultivating it, and its subsequent preparation in order to obtain the fibre.

For an account of the intoxicating leaf and resin yielded by this plant, the reader is referred to Division I., Sub-class (E), on Intoxicating Drugs.

The distribution of hemp is very wide indeed. New Zealand forwards a supply as well as Italy; but that of the latter country yields the best, the whitest and the softest. The dry warm climate of the country appears peculiarly suitable to developing the qualities of hemp.

The Italians have a saying that hemp may be grown everywhere, but it cannot be produced fit for use either in heaven or earth without manure!

Hemp when cultivated in this country for bhang, is sown thinly, but it is necessary to sow it thick, in order to make the plants shoot up into tall wands for fibre. The thick growth of the plant produces shade, excludes light and air to some extent, and by keeping in moisture and shading off the heat, prevents the rapid evaporation of sap.

The possibility of the successful cultivation of hemp in India, was suggested as early as 1800 by Dr. Roxburgh*; although Mr. Deneef succeeded in growing excellent hemp in Bengal, and a fibre of good quality has been, and may yet be, produced in various parts of the plains, yet the hemp of the Himálayas of Garhwal, Kamaon and Kot Kangra, is very far superior in strength; even at Saharanpúr, where the bhang plant was made to grow to a height of 10 to 12 feet. Dr. Faulkner reported that the fibre was not equal in strength to that of the Himálaya.

* It is to be found at elevations from about 5000 to 9000 feet.

† Illustrations, p. 332.

* Royle's Fibrous Plants, 320.

A two-inch rope of Dera hemp bore up to 2,519 lbs ;* but a sample of hemp from the division of Kúlú, in the Kangra district, did not break with 400 lbs., when rhea fibre gave way with 320 lbs., and Petersburgh hemp with only 160.

Dr. Jameson mentions that on showing some pattern samples of Russian hemp to some Hill cultivators, they said that if they produced such inferior stuff they would not be able to find a sale!

The estimated value of the Himálayan hemp is about £35 per ton. Hemp when first asked to be sent home by the Court of Directors, was procured at the rate of from 4 to 6 Rs. per maund (= £10 16*s.* and £16 4*s.* per ton), including cost of carriage to England, this would cost £25 16*s.*, or £31 4*s.* altogether.

The difficulties of rendering the fibre produced in the Himálayan districts a profitable article, are great, on account of carriage, though no doubt the produce of Garhwal and Kamaon will be greatly facilitated by the river carriage on the Ganges. The quantity of hemp actually under existing circumstances exported from India is large, and increasingly so, though the returns are not very trustworthy, from the high probability of sunn and *Hibiscus* fibres, and perhaps some jute, &c., being included as "hemp."

In 1803, the exports were only 4738 cwts., and 1851, *before* the great pressure of the Russian war, they had reached 590,923 cwts., which is an increase of more than one hundred-fold in 50 years!

We must now pass on briefly to consider the cultivation of hemp in the Himálayan provinces, and what methods are adopted for preparing the fibre. The following extract from a letter of Mr. Batten, Senior Assistant, to Mr. G. Lushington, Commissioner of Kamaon,† well describes the Himálayan varieties.

The natives divide hemp into three species, viz., Gunarabhunga, Goorbhunga, and Phoolbhunga. The first named kind is also called "jinglee, or bun bhunga," and is that which is seen everywhere throughout the hills, growing wild ; and indeed, during the rains, forming the chief portion of the rank vegetation, especially in the neighbourhood of houses. A little charras can be extracted from the flowering portion of this plant, and an inferior rope can be made from the fibres, but in general this species is considered and treated as useless. In cold situations, especially near the sheds of pasturing cattle, this wild plant often attains to the height of ten feet. In botanical character, there is I believe, very little if any difference between this indigenous production, and the true *Cannabis sativa*. "Goorbhunga" is the cultivated kind, and is grown from seed, the first introduction of which into the hill agriculture, whether from the wild plant of the country, or from elsewhere, is not now discoverable. The seed is always procurable in the bazar, and is generally sold at about Rs. 3 a maund. In the interior the price is often cheaper, and in Shor, about 16 nalees, or not quite thirty seers, are sometimes procurable for the rupee, when the seed is purchased for culinary purposes. The sowing takes place in the Hindoo months, Jeyth, Assar, or from the middle of May to the end of June. In warm situations the hemp is sown rather later, in order that the heat and damp of the rains may cease before the plant shall have time to run into useless stalk and excessive seed. During July and August, the ground about the plants is hoed, and fresh earth heaped up about the roots. The "goorbhunga" is ripe in Kartik, *i. e.*, from the middle of October to the middle of November. Cold and high situations are almost exclusively chosen in Garhwal for hemp crops, and in that district I do not recollect ever having seen cultivated hemp below the level of 5,000 feet above the sea, and very rarely even at that level. It is generally to be found between 6,000 and 8,000 feet, but in Kamaon the situation of hemp-growing villages is rarely so high ; and a cold climate, though preferred to that found at elevations below 5,000 feet, is not considered absolutely necessary. The favorite situation for the cultivation of hemp is a cold, dry upland ground, with a good soil, and with facilities for manuring, manure being most essential for the proper growth of the plant. Hence we generally see hemp crops in the immediate neighbourhood of the village homesteads, or if at a distance from human habitations, very close to cattle-sheds and pasturing grounds on the upper ranges of mountains. Hemp crops is supposed to exhaust the soil, and the wheat and barley, which are commonly sown in succession thereto, are said to be defective in quantity and quality. The "phoolbhunga" is described by all my native informants as self-produced in the field where the "goorbhunga" is sown. As far as I can judge, however, it is merely the barren plant.* It produces a blossom, but no seed, and the leaves are exactly similar to those of the "goorbhunga." This plant ripens earlier than the "goorbhunga," and is that which has the most valuable fibre. It is useless for the production of charras.

The culture of hemp is as follows :—

The ground is cleared at the end of May or in the

* *See* Journ. Agri-Hort. Society, III., p. 227.

† Papers on the hemp cultivation in India.

* It is the male plant. Hemp is Dioecious.

beginning of June; the quantity of seed is about from 26 to 33 seers, 9 seers per acre (which is nearly the equivalent of the "besi" of Garhwal).

During their early growth the plants have to be kept free from weeds, then the crop will grow up to even 12 or 14 feet, and is cut in September to November.

The male plants produce the strongest fibre, and are cut some weeks earlier, the stalks are then dried somewhat, and made into bundles and steeped for 8 days or more, they are then taken out, beaten with wooden mallets, and dried; the fibre is stripped off, from the thickest end of the stalk, and is again beaten and made up into twists for sale.

The average return per "besi" or acre is—

	Value.
3 seers of "churras,"	6
4 maunds of hemp, ...	8
30 to 35 seers of seed yields 5 seers of oil,	1
	Rs.* 15

It is curious that in some parts of Kamaon the cultivation of hemp is looked on as a mean occupation, and "hemp-grower" is a term of abuse, the same contempt is felt in parts of the Dekkan for the cultivation of "san."†

In the plains, hemp is always manured, bearing out the Italian proverb before alluded to. In Europe, hemp is either steeped in water, either standing or running, the former appears on the whole the best; or else is subjected to "dew-retting," and in Russia to "snow-retting;" the latter processes are complete when dark spots appear on the hemp stalks: after this they are dried by being spread out on grass, they are then peeled by breaking the end stalk and slipping off the bark; it is then subjected to the break, or "brake," between fluted rollers, and then scutched and the longitudinal fibres separated by beating.

The probable costs of carriage, &c., are clearly detailed in the following paragraphs of a letter from J. H. STRACHEY, ESQ., Assistant Commissioner, Garhwal, to J. H. BATTEN, ESQ., Commissioner of Kamaon, No. 41, dated 28th July, 1854.

"Assuming the price at the foot of the hills to average Rs. 6 a maund, the cost per ton will be about Rs. 164.

"I have no data to enable me to give the cost of transport from the foot of the hills to Calcutta with any exactness, but it will probably be about Rs. 45 per ton. CAPTAIN CORBETT'S estimate from Sun-

* ROYLE p. 323. No account is taken in this of the value of *leaves* as "bhang."

† For an account of the cultivation in Naipal, *see* ROYLE'S Fibrous Plants, 323.

eah, Chilkeea, and Kotdwara, is £4 4*s.* per ton; CAPTAIN HISKE'S, from Dehra, is £4 2*s.*; I will assume it to be Rs. 50, which will I believe be considerably above the actual cost; and this will give for the price of the hemp in Calcutta, Rs. 214, or say £21 8*s.* per ton. DR. ROYLE states that it may be assumed that a price of at least £35 per ton will be given in England for fibre of superior quality. I assume, which I believe I may very safely do, that the Kamaon and Garhwal hemp will be at least equal to the best Russian. At this rate we have £13 12*s.* to cover the freight, and all other charges between Calcutta and England.

"There can be little doubt, under these circumstances, that the Himálayan hemp may be profitably exported to England. It must be remembered too, that while I have estimated the price of the hemp at Calcutta at a sum that will in all probability be above its actual cost, the price mentioned by DR. ROYLE, as obtainable in England, will almost certainly, for some time at least, be very considerably increased. I have not the means of ascertaining the present price of hemp in England, but £35 per ton, the sum which DR. ROYLE names,* has not been an unusual price for the best Russian and Italian hemp, even in time of peace, and at one time, during the last war, the price rose to £118 per ton, while even the Indian jute, which usually sells at £12 to £15 per ton, rose at one time to £35 and £40 per ton.†

Although we must not assume that war prices will last for any great length of time, the quality of the Himálayan hemp appears to be so admirable, that when it has once become known in the English market, it will certainly always fetch a high price.

In conclusion, the following suggestions as to the preparation of the fibre and the best way of establishing its reputation in the market are extracted from the "Papers concerning Hemp Cultivation."

"The culture seems to be very well understood in many parts of the Hills, as they carefully prepare, and usually manure, the ground, thin the plants to within three or five inches, and cut the male plant, "phúl bhanga," which flowers, but has no seeds, a month or six weeks before the female plant, 'gulanga,' or 'gulbhanga,' which has seed, the latter being cut about the end of September.

"As the preparation is also understood, the cultivators should be required to do this in their best way, so as to produce a clean and uniform article, in long

* DR. ROYLE wrote before the commencement of the war in Europe.

† MCCULLOCH'S Commercial Dictionary. Art. Hemp.

lengths, without twisting or platting the ends up in any way, and to resemble the Petersburgh hemp as nearly as possible.

"The hemp sent by D. F. McLEOD, ESQ., as the produce of Kúlú and Lahaul, having been highly approved of in this country would no doubt sell well, if sent to market. It is desirable therefore to send a sufficient quantity, to have its properties more extensively tested, and its value established in the English market.

"Though it will, no doubt, be necessary in some cases to increase the original price of these fibres, as in the case of the hemp, or perhaps of the rhea, for a time, so that when more extensively cultivated its cost shall have been ascertained, it is to be carefully kept in view that any great increase of price in the articles will prevent their becoming permanently established as articles of commerce, as that would interfere with the profits of all those engaged in the transaction. Though the price of all fibres is at present high, it is uncertain how long this may continue; but it may be safely assumed that if care be taken to make their superior quality known to proper hemp brokers, that all which have been mentioned will come into competition with the best kinds of hemp, and sell for about £35 a ton.

The following list shows the weights at which fibres tested at the Military Stores, respectively broke :—

	lbs.
Petersburgh clean hemp, ...	160
Wild rhea, ...	343
Jubbulpore hemp, ...	190
China grass, ...	250
Rhea fibre, ...	310
Kot Kangra hemp, no breakage at, ..	400
Wukkoonar fibre, ...	175
Yercum or mádar fibre, ...	190

"Clean samples of all the above fibres were taken, of equal weights and firmly tied at their ends, so as to be of equal lengths, at the India House, and their strength tried in the usual way by MR. HULL, in the Military Stores.

The samples of Himálayan hemp (bhang), (*Cannabis sativa*) were as follows :—

Simla States—
(4736) Bhaji,
(4743) Sirmúr.
(4745) Koti.
(4747) Balsan.
(4749) Baghat.
(4753) Tiroch.
(4754) Rampúr of Basahir (MR. TER ARRATOON).
(4755) Karaiti (THAKUR OF KARAITI).
(4758) Jubal.
Kangra (Palam valley).
(4824) Lahore Museum (from hills).
(4849) Lahore Museum (rope of Himálayan hemp.)
(4896) Gujranwalla ("bhang-ka-chál"), (the fibre of the bhang plant).
(4915) Gujrat (specimen of rope also).
(4978) Kashmír (post bhang).

1753.—[ ]. San (*Crotalaria juncea*).

This plant is often confused with the "sankokra," (called sanni in some parts), *Hibiscus cannabinus*, to which it is much superior in strength. The species is known in commerce as "sunn hemp," Concanee hemp; Salsette or Bombay hemp; and brown hemp. Though called hemp, it is hardly necessary to observe that the plant has no connection botanically or otherwise with the true hemp (*Cannabis sativa* or *Indica*).

DR. ROYLE remarks on the similarity of the Spanish broom (*Spartium*) to this plant; the former is well-known at home from the tough fibrous nature of its branch twigs. As early as the close of last century, sunn began to attract attention in Europe, and a treatise on hemp and the Sun Plant, was brought out by WISSET in 1804.

The san plant is cultivated all over India. The "wukkoonar," fibre of Travancore, though different at first sight, is really the *Crotalaria juncea* somewhat altered in its growth by locality and climate.* "San" is also produced on the Malabar coast, and in the Bombay presidency. The Jabbalpúr hemp is produced by *C. tenuifolia*, which WRIGHT and some other botanists consider to be only a variety of *C. juncifolia*; but ROYLE makes it a different species.

The time of cultivation for "san" is generally during the rains. A clayey low-lying soil is bad; a high, somewhat dry situation, is best; and a too rich soil produces coarse fibres. The "san" is sown thickly. If the seed is sown when the first shower falls in June, in August or September, the plant will be in flower, and from 5 to 8 or 9 feet in height. If the plant be wanted for fine soft fibre, it is cut in flower; and if for strength it is grown until the seed ripens, before cutting. The plant is either cut or pulled up by the roots like flax. The produce of an acre is given by ROYLE at a medium of 700 lbs.

The san after being cut is steeped. According to the climate and seasons, the duration of the steeping is fixed. In August and September, 2 or 3 days are sufficient,† the completion of the process is known by the facility with which the bark separates. At this stage, workmen go into the water, take up the stalks in

* *See* ROYLE's Fibrous Plants, p. 285.

† If cut when the seed is ripe the fibre requires much longer steeping.

handfuls, and heap them in several places; they then grasp the bundle by one end, and beat it on the surface of the water, which quickly removes the cellular matter from the fibres: they then turn the bundle, taking hold of the other end, and treat it in a similar manner. The natives to complete the process merely wash the fibre, and hang it up on branches to dry. A hemp brake and scutching machine are unknown, and might be advantageously introduced.

The great point to be attended to, in preparing fibres of woody plants is to get rid of the sap and vegetable matters as soon as possible; it is the fermentation of these that hastens the decay and weakening of the fibres.

Of the value of "san" for a rope fibre,* there can be no doubt. CAPT. THOMPSON of the firm of THOMPSON & Co., ropemakers, Calcutta, wrote of some Malabar "san" that it was equal for mill purposes to Russian hemp, and that if well prepared it might completely supersede the Europe made cordage. Some interesting particulars about the strength of san are given by DR. ROYLE, at page 278 of his "Fibrous Plants of India."

A sample of san fibre sent to the Exhibition of 1851, bore only 150 lbs., but an older sample received in 1802, bore 175 lbs., and Petersburgh hemp gave way at 160 lbs.

The value of good san appears to be from £18 to £20, and £25 a ton in England, while the "wakkúnar," was worth £35.† In 1854 (December) san was as high as £33. Of the san fibre, MR. DICKSON said, that when prepared with his Patent Liquid, it "became soft, white, and so fine, when heckled, as to bear the closest comparison with flax at £80 per ton. It is better than any Russian flax for fine spinning."

The other species are *Crotalaria tenuifolia*, Roxb.; *C. retusa*, L., called "bil jhanjan" in Bengal; *C. verrucosa*, L. (*C. cærulea*), "bansan."

I cannot better conclude these remarks on hemp cultivation, than with the observations of DR. JAMESON.‡ After detailing the form in which Russian hemp comes to market, and the system of advances, &c., practised, he says, in para. 11—

"I have mentioned these particulars to the Board, in order that they may see how the important trade of hemp and flax is carried on in Russia, and which might with much advantage be imitated in this country. For Government to do so on a large scale is not necessary, but to bring about a brisk and thriving trade, the initiative must, I think, be done by them, and the remainder might then be left to the mercantile community. Let a system, similar to the Russian, be introduced into this country, viz., small advances or "hand money," paid to natives, and inspectors appointed to give advice on cultivation and preparation, and I am confident that the North Western Provinces would turn out any supply of good fibrous stuffs. But it must be first ascertained, by the transmission of samples, that the fibrous stuffs are fitted for the home market, and that they can realize prices in England, to admit of a small advance on the rates of sale now prevailing in India, and thus admit of better cultivation, and more care in preparation, and thus the production of better fibres. But before this can be effected, in a country where indolence, apathy, indifference, and want of zeal prevail, an inspector or inspectors, as stated, must be appointed."

The samples of "san" or "sanni" (*Crotolaria juncea*) were as follows:—

(4722) Hissar. Value, 4 Rs. per maund (sown at the edges of fields).

(4724) Rohtak.

(4731-32) Ambálah, of two qualities.

(4768) Kangra (Haripúr).

(4817) Lahore.

This district also exhibited from the Tahsíl of Sarkpúr, a sample of the plant unprepared, with its leaves and seed vessels, &c.; and a sample of rope from the "san" made at the Central Jail (4848).

(4936) Gugaira (sanni).

(4960) Dera Ghází Khán (sanni).

(4969) Peshawur.

(4693) Kapúrthalla.

(4978) Kashmír.

(4982) Nabha.

(4987) Pattiala.

(4990) Maler Kotla.

1754.—[4702]. Wild hemp, "janglí san." Spiti. KANGRA LOCAL COMMITTEE.

1755.—[4912]. Old gunny cloth and tát, used in paper making. GUJRAT LOCAL COMMITTEE.

1756.—[4933]. "Khip" or "khif" (*Crotalaria burhea*). Thal of Khúshab, Shahpúr. DEPUTY COMMISSIONER.

Called a *Leptadenia* in the Local List. It is used for making rope (*see* Plate).

1757.—Jhijjan (*Sesbania aculeata*), (formerly *Æschynomene cannabina*, Roxb. Flor. Indica, III., 335).

* It is mentioned by DR. BUCHANAN HAMILTON, in Mysore, as making a stout gunny cloth also.

† REYLE'S Fibrous Plants, 286.

‡ In his Reports addressed to the Board of Revenue, on Fibres, submitted 1855. (Hemp Papers).

CROTALARIA BURRHEA.

A few specimens of this fibre appear. Two grown near Lahore, and some from Gujranwalla and Gugaira were exhibited; it is like "san," but somewhat coarser and darker colored. It is highly probable that this is the *Sesbania aculeata* formerly *Æschynomene cannabina*. The plant is called "dhandain" in the North West Provinces, and *jaganti* or *jajanti* in Bengal, and a fibre very similar, the *Crotalaria retusa*, is called *Bil jhinjan*. It is said to spring up in rice fields, and other wet cultivation during the rains. When cultivated it is sown after the first showers of the rainy season, and requires less weeding than "san," but a low and moist situation; it is ready to cut about November. It will grow as high as 6 to 10 feet in Bengal, and is supposed to be very suitable for water cordage, as it does not easily rot. This is the same as the "dhunchí" fibre, which was valued at from 30 to £35 per ton.

Mr. Deneef* showed a sample to the Agri-Horticultural Society in 1840, and said that a begah would yield 173 lbs. of fibre, and 92 of seed. A woman can dress 4 lbs. of fibre in a day.

In 1862, "jijjan" was noted as having recently come into use at Lahore, owing to the high price of other fibres: the Punjábí samples though strong, are coarse and badly prepared, and are not worth more than £8 or £10 a ton.

Samples of the "jhijjan" plant were sent from—

(4825) Lahore (grown at Sanda), by Chaudri Imam Baksh.

(4826) Fibre of do.

(4853) Rope of do. (obtained from Gujranwalla).

(4939) Gugaira.

1758.—Sankokra (*Hibiscus cannabinus*), (Malvaceæ); sankukra; sanukra? sanni (Saharunpúr), &c.; patsan, Delhi; ambarí (Hindústán, westward); méstabít (Bengal).†

This is a long fibre-yielding plant, which makes a good fibre for matting, &c., but is weak in comparison with "san" and "jhijjan."

It is the produce of a tall *Malvaceous* plant, distinguished by its large sulphur-yellow flowers, with purple centres. It is usually sown as a kind of hedge on the borders of other crops, and requires about three months to come to perfection.

It is steeped and prepared like "san." "Dr. Roxburgh, when experimenting with this fibre, found that a line made of fibres from plants *in blossom* broke with 115 lbs., but, with only 110 lbs. when the fibre was from plants whose seed had ripened." And in Dr. Wright's experiments, "sankokra" broke with 290 lbs. when "san" bore 404 lbs. When carefully prepared, the "sankokra" will divide into very fine fibres, and furnishes a fibre 5 or 6 feet long. There were samples of the fibre thus prepared from the Central Jail, where good door mats are made of it.

The leaves of this species are in some places eaten as a vegetable, having an acid flavor.

The calices of the Roselle plant (*H. sabdariffa*), are fleshy and acid, and are used as a fruit, and converted into a jelly under the name of "patwa."

The Roselle fibre is also good. *H. furcatus*, *H. mutabilis*, and *H. tiliaceus*, all yield fibres.

Malvaceous plants of the genus *Sida* yield cordage fibres in China.

The specimens of *Hibiscus* fibre (sankokra) were as follows:—

(4769) Kangra (Palam valley). Sells at about 12 seers per rupee.

Lahore Museum series—

(4821-23) The fibre in different stages, from the stalk just crushed to the perfectly developed fibre. A sample of the plant was also sent.

(4851) A rope of this fibre. Chaudri Imam Baksh.

(4897) Gujranwalla.

(4972) Kapúrthalla.

(4708) Delhi; where it sells at Rs. 2-8 a maund. The woody part is used for making lucifer matches.

Still within the produce of our 2nd division of fibres principally valuable for rope-making, we approach that series of fibres which was described in the preliminary notice on the botanical nature of fibres generally.

We here conclude the list of those fibres, which, belonging to the *exogens* or "outside growing" order, are separated from the cellular barks of the plants producing them, by the process of steeping, breaking, scutching, &c. It is these that form the more valuable fibres for the market, and they require much preparation; their final process, "heckling," separates from them all the shorter fibres, leaving the long uniform ones as the staple, and the residue as *codilla* or *tow*, useful in a variety of ways for coarse fibres, for packing, and for paper making, &c.

The series of fibres we now enter on are

* Royle, 295.

† In the Purneya district it is called "ambaya pata," and in Behar "kudrum;" the variety of its names shows how universally it is cultivated in India.

those barks of the stems and roots of exogens, where the external cellular bark is comparatively insignificant, and the inside layer of woody fibres, comparatively predominant and tenacious; so that the barks often yield a strong rope without further preparation than separation from the parent stem and twisting. Such are the following:—

1759.—[4751]. Bíhul, fibre of the *Grewia oppositifolia*. Tirwah (Simla). RANA OF TIRWAH.

Also a sample (4759) from Jubal (Simla). (4767) is a specimen from the foot of the Kangra hills by the name of *dhâman* or "bíhul." "Dhâman" is also known in some places as "thâman," and "dâman" (without aspirate), or "tâman." "Bimal" or "bhímal" in Garhwal and Kamaon. DR. JAMESON adds "bhengúl."* Its Pushtú name is "pastawane." Yields a strong fibre for ropes and nets: not exported.

A sample of a rope of "fálsa," among CHAUDRI IMAM BUSKH'S Lahore collection, and said to come from the Hills—may probably be *G. oppositifolia*.

CAPTAIN HUDDLESTON, describing the "bhímal" in Garwhal says, the leaves of the stalks are given to cattle, the stalks are then soaked in water forty days, and then beaten with stones to loosen the bark, which is afterwards peeled off. One tree gives about 5 seers of fibre.

1760.—[4761]. Tawar or tór, Elephant creeper. *Bauhinia racemosa*, Lam., or *B. scandens*, Willd., or *B. Valhii*. Hills near Simla. MR. GEORGE JEPHSON. Called also "gaj-bel."

The *Bauhinia racemosa* is also called "málú" and "máljhan" and "kandli" in Garhwal and Kamaon.

The plant is a climber with immense large two-lobed leaves, which dry a reddish-brown color, and are made into umbrellas in the lower hills (where the plant is abundant), by spreading them on a framework of bamboos, and netted with string to keep the leaves together; such an umbrella was exhibited from the Hushyarpúr district.

This climbing plant hangs in elegant festoons around other trees. There are two or three beautiful specimens over-growing lofty trees in the Badámí-bágh at Lahore. The flowers are beautiful in appearance, and the seeds are eaten raw, and are said to be like cashew nuts. The fibre of the bark is sometimes softened by boiling, but oftener peeled off while green, twisted and allowed to dry. Specimens of *Bauhinia racemosa* ropes are mentioned by DR. ROYLE as sent to the Exhibition of 1851 from Bhagulpúr, under the name of *Patwa* or *Mawal* fibre.

The fibre of *B. scandens*, common in Silhet, was tested by MAJOR JENKINS,* and a line made of it sustained for 45 minutes a weight of 168 lbs., stretching only 6 inches in 3 feet. It is about the same strength as the best "san."

There was a sample (4776) from the foot of the Kangra Hills, where it is described as used to make ropes for bedding, and the bark, which burns or smoulders slowly, is used for a slow match.

The following description of the "málú" is from CAPT. HUDDLESTON'S Report on Hemp in Garhwal, 1840.

"The 'malloo' is a large creeper plant growing abundantly throughout the district at the bottom of narrow and hot valleys, along the sides and precipices of rivers and in ravines, forty or fifty yards in length and of considerable thickness, from the bark of which a very strong rope is made. The natives chiefly use it for tying up their cattle, and sewing their straw mats with the fresh bark; it also makes capital matches for guns, and muzzles for oxen and calves. The leaves, which are heart-shaped, and above a span in breadth and the same in length, are made into "cháttas," are sewed together with twigs for baskets for holding pepper, turmeric and ginger, and are brought to Sreenuggur in great quantities for sale, being used by the poor instead of dishes to eat off, and the bunneahs wrap up their goods with them; a load of the leaves fetches about 2 annas: the broad flat seed of the pod is also eaten after being fried. This creeper is cut generally in July and August, though it may be cut all seasons, and the outer bark being stripped off is thrown away, the inner coating being used for ropes, as wanted, by being previously soaked in water and twisted when wet. A large creeper will produce a maund of fibre, called 'seloo.' The bark before being used is boiled and beaten with mallets, which renders it soft and pliable for being made into ropes and string for charpoys. Though this fibre makes very strong ropes, it is not over durable, and rots if kept constantly in water; it will last about 18 months, but requires occasional soaking, and I am informed that when coated with tar it does not last much longer. The fibre is not collected for sale, but only for the natives' own use as they may require it; but any quantity, I imagine, might be obtained, and at cheap rates."

* Catalogue, Saharunpore, 1854, p. 74.

* ROYLE'S Fibrous Plants, 297.

1761.—[4775].—Karálín or "kachnár." Kangra. LOCAL COMMITTEE.

This is described in the Local Catalogue as the bark of a large tree growing in the Palam and Kangra valleys. "Kachnár," given in the same list as a synonym, is the *Bauhinia*, the flower buds of which are eaten boiled with meat as a vegetable, and to make (as it is asserted they do) the meat tender.

There are no particulars given of its use as a fibre.

1762.—[4771].—Jáman kúmb. Kangra. LOCAL COMMITTEE.

No habitat or uses given: described as the fibre of a climbing plant, which has frequent knots or joints, which makes the fibre short. Fibre fine and white.

1763.—[4772].—Giddar kumb. Kangra. LOCAL COMMITTEE.

A climbing plant, bark used as a fibre, not described, and habitat not noted. Fibre white and coarse.

In CAPT. HUDDLESTON'S Report on Hemp Cultivation in Garhwal (1840), he describes evidently the *B. racemosa*, or "tawar," under the name of "kúmbí."*

1764.—[4777].—Lasúrá (*Cordia myxa*). Kangra. LOCAL COMMITTEE.

The fibre is not much used. A sample was sent (4881) in the Lahore collection.

1765.—[4865]. Gondni bark (*Cordia angustifolia* or *C. Rothii.*) CHAUDRI IMAM BAKSH.

The fibre was made into a rope for exhibition.

1766.—[4778]. Sálangan. Kangra. LOCAL COMMITTEE.

Undescribed, and little used. The bark of a tree.

1767.—[4779]. Dhák or paláh fibre. Kangra. LOCAL COMMITTEE.

This is the bark of the "palás" (called "paláh" in Kangra), *Butea frondosa*, which has often appeared, both as yielding a gum and for its flowers which form a dye, and now for its bark's fibre. This is not likely to become an article of commerce, but is useful enough locally for agricultural purposes. A sample of the rope was sent from Lahore (4857), and two samples from Pattiala—both of root and the fibre (4985-56).

1768.—[4839]. Bark of the *Celtis caucasica*, or nettle tree (Ulmaceæ). Chamba Hills. LAHORE MUSEUM.

The nettle trees (Ulmaceæ) are not to be confused with the nettle fibres of the Urticaceæ, &c. The sample is a thick rope of a brown color, and of considerable strength. It is used in Assam to make a coarse cloth.

The inner fibres of the bark are by natives reticulated into a kind of fabric. The leaves are said to be used in polishing horns.*

1769.—[4861]. Coir rope; cocoanut fibre (*Cocos nucifera*). Imported from Hindústán. CHAUDRI IMAM BAKSH.

This fibre is scarcely ever seen in the Punjab; and as there is no chance of its ever growing here, or becoming an article of trade, it is of little importance to the Punjab. It is not so strong as some, breaking at 204 lbs. when hemp bore 407 lbs.; but as a fibre for matting and as resisting the action of water and and other valuable properties, it is well known and an extensively exported article of commerce.

1770.—[4808]. Bark of the mulberry (*Morus indica*). Lahore district. CHAUDRI IMAM BAKSH.

The Moraceæ are not generally known as fibre-yielding plants, except as regards one or two of their number. *Broussonetia papyrifera* has a fine reticulated inner bark, which, in the islands of the Southern Ocean, makes a good and even fine cloth, and also a paper. As to the use of the white mulberry, ROYLE quotes MARCO POLO, who describes the Chinese as peeling off the thin inner bark of the trees on which the silk worms were fed, and then steeping the material, and afterwards pounding it into pulp in a mortar. The author adds, this is made into paper resembling that which is made from cotton.

The experiment of making pulp from the mulberry bark has actually been tried, and with some success.†

The mulberry tree is very common in the plains of the Punjab, and its bark might be utilized.

1771.—[4877]. "Resha bar" (*Ficus indica*). Lahore district. CHAUDRI IMAM BUKSH.

The long fibrous roots of the "banyan."

The tree throws down from its branches long aerial roots which finally thicken and take root again. It is very little used as a fibre, but exhibited to show what there is available. It is used, however, as a "falíta," or slow match, for the native matchlock.

1772.—[4875]. Coarse rope, made

* See Paper on Hemp Cultivation. Appendix, p. xxiii.

* DRURY'S Useful Plants, p. 124.
† ROYLE'S Fibrous Plants, 343.

from the sugar-cane after the juice is expressed. Lahore. CHAUDRI IMAM BUKSH.

A coarse but strong fibrous rope: used for agricultural purposes, but it is too coarse and woody to be turned to account as a fibre.

A sample was sent from Gujranwalla (4898).

1773.—[4774]. Olín. Kangra. LOCAL COMMITTEE.

A fibre obtained from the sheaths of the leaves of a kind of palm (*Chamærops?*) which grows in the Kangra hills up to 5000 feet.

The last series of fibres are the grasses, or those endogenous plants, which yield fibre from the long leaves or sheaths enclosing the stem, like the plantain.

The grasses are exhibited in the form of ropes, merely dried and without preparation. In most fibre-yielding plants it is necessary to separate the mucilage, cellular, and the sap from the fibre (?) before it can be utilized. This is the case not only on account of the obstruction to the subsequent processes offered by the woody matter, &c., but because the presence of the sap tends to produce decay; but in the long narrow blades of grass, the quantity of foreign matter is so small and dries up so quickly, that the leaf simply dried is twisted into a rope.

Only one or two of these are extensively useful.

The plantain, of which is made in other parts Manilla hemp and fibres that are subjected to careful preparation, is in the Punjab only rarely to be seen as a fibre, and then the outer sheath is merely dried like a grass and twisted into a rope; otherwise, no doubt, the plantain should have been included in the textile fabrics as subjected to a course of preparation to obtain the fibre.

The production of this valuable fibre is yet a desideratum in the Punjab, and as the plant grows well enough, there can be no reason why it should not be. The *Saccharum moonja* is perhaps the only grass that is extensively useful. The other grasses are used for fodder, or for ropes, by the agriculturists only when they cannot get anything else.

1774.—[4862]. Rope of the plantain fibre (*Musa paradisica*). Lahore. CHAUDRI IMAM BUKSH.

The distribution of the species of Musa is very wide. There is the *Musa textilis* (Manilla hemp) in the Philippine Islands; several species in the Malayan peninsula; several in the Malabar coast and over the South of India. In Bengal it flourishes; and it is found up to the north of India, even to 30° of north latitude, and up to 4,000 or 5,000 feet above the sea level in Garhwal and Kamaon.

As regards the value of the plantain as a food-producing plant, the reader will find an interesting account of it at pages 69, 70 and 72, of ROYLE'S Fibrous Plants.

In the Punjab the variety of the fruit commonly seen is large, and somewhat insipid, and inferior to the small and pleasant-flavored plaintains of Bengal.

The art of making flour from the plantain, or preserving the fruit is, I believe, unknown in the Punjab.

It is said that the plantain will grow in the poorest soil and near even brackish water. "A sucker being planted, soon attains maturity—some varieties in 8 months—others within the year, each producing a bunch of fruit, which may weigh from 25 to 40, and even 90 pounds. Each throws out from its roots and around its stem from 6 and 7 to 8 and 10 fresh suckers. These form each a distinct plant." The suckers are cut down annually.

The fibre may be easily separated by scraping the pieces of the stem and sheaths on a flat stone or board, with a piece of hard wood, made like a wooden knife.

The leaf stalk from which most fibre is obtained (as also from the inside of the leaf), has the greatest quantity of the cellular pulp which has to be removed on its upper surface, that should therefore be scraped first, and then turned over and the other side scraped; the fibres are then washed to free them from pulpy matter, and dried *in the shade*. The sun-drying gives the fibres a brownish tinge. In the West Indies the plantain trees are cut down and heaped together, and allowed to ferment, which softens the cellular, and allows of the easy separation of the fibre, but this must weaken it. The expressed sap is said to have tanning properties.

These plants might be cultivated in jail gardens and made much use of. As yet in the Punjab the plant is comparatively uncommon. Paper of excellent quality has been made of it at the Gujrat Jail. Of this mention will be made hereafter.

1775.—[4874]. Bark of the carda-

mon plant (*Elettaria*). Lahore. CHAUDRI IMAM BAKSH.

The cardamon plant grows in the Punjab, but does not fruit. The leaves and sheaths of this plant, and other *Zingiberaceæ* no doubt abound in fibre, being similar on a smaller scale to the plantain fibre. The sample sent was more as a curiosity and a sample than a fibre used or recognized.

GRASSES.

1776.—[4712]. "Káns" (*Saccharum spontaneum*). Delhi. MUNICIPAL COMMITTEE.

1777.—[4713]. "Dáb" grass, or "dabhah." Delhi. MUNICIPAL COMMITTEE.

This is the *Anatherium muricatum*.

This grass is also called *khawi* or *khavi*, under which name specimens were sent from—

(4932) Khúshab of Shahpúr.

And also *panni*, under which name specimens were sent from

(4873) Lahore.

(4938) Gugaira.

The root or "khas" will be noticed among Thatching Materials. The flower of the grass is called "*gul-i-izkhar*," and is used for flavoring and scenting in distilling spirits, and in medicine.

1778.—[4714]. Múnj (*Saccharum munja*). Delhi. MUNICIPAL COMMITTEE.

This most useful grass is very common in all parts, and grows under several names. The leaves are long and narrow, and grow in large tufts around the base; the flower stems, which are surrounded by the sheaths of leaves, which appear at intervals up the length of the stem, rise to a height of 10 or 12 feet, and are crowned with a wavy grass flower, which has an exceedingly elegant appearance; the sheaths of the stalk are covered with minute spiculæ, which are painful if the plant is roughly grasped. The leaf sheaths surrounding the stalk, as well as the dried leaves on the flower stalk, furnish a material, which, when slightly damped, is twisted into twine of various degrees of fineness and considerable strength; and if well made, presents a beautifully neat glossy appearance.

The tuft of true leaves at the base is called "sar" or "sarkara," and is only used in thatching houses (*see* Materials for Thatching and Matting).

The tall flower stem, stripped of the involucre, is a glossy jointed light stalk, this is called "sarkanda" or "kánná." They are collected, and when a number of them are arranged and kept together by strings passed through them consecutively at proper intervals, they form an open screen or "chick" for verandahs, which admits air, but excludes the sun's rays. A number of ingeniously made chairs, sofas and stools, are made out of "sarkanda." The reeds being placed across and across like lattice work, are bound together with "múnj" string; the seats of the chairs, &c., are made of string platted and interwoven, which are sometimes covered over with leather, and are a light, cheap and useful furniture. The tapering tops of the flower stem, after the ripe seed has been brushed off, form what is called "sirka" or "sirki," and are formed into a kind of thin thatching.

Múnj grass was exhibited from—

(4782) Kangra.

(4918) Jálandhar.

(4928) Bhera (Shahpúr).

(4963) Dera Ghází Khán.

(4974) Kapúrthalla.

(4988) Pattiala.

(6967) Peshawur (Yusufzai).

The fibre when the leaves are dried and arranged in bundles and ready for string-making, is called "bán múnj."

A specimen was sent from—

(4896) Gujranwalla, and Jhang (4944).

Múnj rope was exhibited from Lahore (at the Central Jail).

(4846) Extra thick rope.

(4844) Thick rope.

(4845) Medium rope.

(4847) Twine.

The fibre sells at 2 or 3 rupees a maund in October and November. It does not rot by exposure to wet.

1779.—[4783]. "Bagar" grass (*Eriophorum cannabinum*). Kangra district. LOCAL COMMITTEE.

Ţeliyás is given as a synonym in Kangra. A sample (4842) was sent from Lahore, but was noted as being brought from the Hills.

CAPTAIN HUDDLESTON gives the following account of it, but under the name of "bhábar."

"It affords a most economical substitute as an article of cordage in lieu of others of a more costly and durable nature. All the 'jhúlas' or rope (suspension) bridges which are erected over the large rivers, where 'sanglás' or wooden planked bridges, cannot be made, on all the principal thoroughfares of this district, are constructed of this silky species of grass, the cables of which, are of a considerable thickness.* These

* Jhúlas are almost invariably made elsewhere of the twigs of the *paser*, or *Parrotia Jacquemontiana*. On the Jhilam, near

rope bridges are a very safe means of communication over the large and rapid rivers intersecting different parts of the country, both for travellers and men with loads; and, where the footway and sides are properly laced with brushwood, afford an easy enough roadway for loaded sheep—but neither ponies or cattle can travel over them. This grass grows abundantly in all the ravines up the sides of the mountains, and is to be had only for the cutting—but it is not of a very durable nature, though pretty strong when fresh made into ropes. It lasts about a twelvemonth only, or little more, and the people in charge of the rope-bridges are constantly employed in repairing and annually renewing the ropes and stays. The 'chinkas,' or temporary bridges, of a single cable, upon which traverses a seat in the shape of an ox-yoke, are also sometimes made of this grass, though these are oftener made from the rope of the 'malloo' creeper, as being stronger and more durable from their being easily let down to soak occasionally in the water. The 'bhábar' grass is made into ropes without any previous preparation save that of being wetted."

1780.—[4733]. Bhábar grass (*Andropogon involutum*). Ambálah district. Local Committee.

Also from Delhi (4712A); the Salt Range (4931); and Jalándhar, where it is called "bhabbar."

1781.—[4854]. Dib grass (*Typha angustifolia*). Banks of the Rávi, Lahore. Chaudri Imam Baksh; also (490) from Gugaira.

Value about Rs. 2 or 1-8 a maund. Mats are also made of it.

1782.—[4855]. Dab (in Hindústání "kúsh") grass (*Eragrostis cynosuroides, Poa cynosuroides*, L). Lahore. Shahdara.

Also from the Salt Range (4930), and Gugaira (4937).

This is the "kusha" or "darhba" grass, so sacred in ancient Sanscrit writings. Sir W. Jones quotes the Veda. "Thee, O *Darbha*, the learned proclaim to be a divinity not subject to age or death. Thee they call the armour of *Indra*, the preserver of regions, the destroyer of enemies: a gem that gives increase to the field. At the time when ocean resounded, the clouds murmured and lightnings flashed, then was *Darbha* produced, pure as a drop of fine gold."

1783.—Dib grass; in Punjabí, khabbal. Creeping Cynodon (*Cynodon dactylum*). (Dúrvá of Sanscrit). Lahore.

This is the common creeping grass which is usually collected for horses by the grass-cutters, and is said to be the best kind of grazing grass. The flowers of this plant present a most beautiful object when examined by the microscope. It is mentioned in the "Atharvan Veda," as the plant with a hundred roots, and a hundred stems.

The following kinds of grass should be distinguished.

1. Dáb, or dabhah (*Anatherium muricatum*).
2. Dab, or kusha (*Eragrostis cynosuroides*).
3. Dub, or khabal (Punjabí), (*Cynodon dactylus*).
4. Dib (*Typha angustifolia*).

1784.—[4875]. Kahi grass. Lahore jungles. Imam Baksh.

1785.—[4856.]. Ser grass (*Imperata Kœnigii*). Banks of the Rávi, Lahore. Imam Baksh.

1786.—[4869]. Mandal straw rope. (*Eleusyne coracana*).

The straw of this crop is flat and excessively tough, so much so that in gathering the crops the heads are pulled off by hand, leaving the whole straw standing.

1787.—[4870]. Rice straw rope, "parálé" (straw of *Oryza sativa*). Lahore. Imam Baksh.

1788.—[4873]. Wheat straw rope, "Itar gandam" (*Triticum æstivum*). Lahore. Imam Baksh.

III. FIBROUS MATERIALS FOR PAPER-MAKING.

The number of substances that might readily be turned to account for this purpose is immense. Many a plant would yield a fibrous pulp quite suitable for paper, though

Muzuffarábád too low for the *Parrotia*, there are jhúlas of ropes made of raw hides. These bridges are truly suspension bridges: 2 or 3 ropes placed side by side form the footing, and above these 2 ropes, one placed one on either side to hold on to; thus a triangle would be formed if a section were made. To keep these ropes in place, ropes are passed round, like a rude balustrade. To prevent the ropes collapsing, cross sticks are inserted at intervals. Only on the Kishnganga river these cross sticks are obviated, by the use of sticks shaped like the letter V, which of course keep the three ropes (the lower and two upper ones) in their place without any horizontal or transverse sticks.

it might not be equal to the strength of a rope, or the eveness of a textile fibre.

At the sametime the refuse (tow, codilla, &c.) of all kinds of superior fibres will yield a paper-making material.

1789.—[4913]. Plantain fibres used in the manufacture of paper. Gujrat Jail. LOCAL COMMITTEE.

(For particular accounts of Paper Fibres and their Manufacture, reference should be made to Vol. II., under the head of Fibrous Manufactures).

1790.—[4914]. Fibrous root of the chichira—dhák or palás (*Butea frondosa*), used in making paper. Gujrát Jail.

1791.—[4786]. Kanera bark fibre (*Daphne oleoides*) called Kuttilál in Hazára, &c.

This grows abundantly in many of the in-montane valleys. The bark is stripped off, and the inner layer of fine bark yields a material suitable to paper-making, like the other species (and a *Desmodium*) which follow.

1792.—[4786]. Niggí (*Daphne cannabina*). Syn.—Jeku (Basáhir); niggi (Kúlú); sannarkat (Kashmír).

It grows in the hills, from 5,000 to 8,000 feet. The following extract from an account of Hill products, published in one of the Select Correspondences, describes the production and uses of the *Daphne*.

"8th May. Chína to Kishang. — The road lay through a forest of *Cedrus deodara* and *Pinus gerardiana*, with numerous bushes of *Daphne mucronata?* of ROYLE, known as 'jeku' in the valley of the Sutlej, a pretty shrub with white flowers, 3 to 5 feet high, with smooth upright pliant branches. The fibrous bark is used in the same way as that of *D. papyracea* in Nepaul, and is regularly exported to Sungnum, Shipki, and Ladákh, for the purpose of paper manufacture. In the coarse of three days I met nine men laden with the bleached bark, neatly tied in small bundles; the fibre being light, 24 bundles 2 feet long and 3 inches thick, forms a man's load. They were all hill men, returning from Rampore to their homes on the frontier, where the *Daphne* is not found.

"With much difficulty I ascertained some particulars of the process of paper manufacture at Sungnum, which we did not visit. It is somewhat as follows, and resembles the obsolete fashion of paper-making by hand in England. Having brought the bark of 'jeku,' from the jungle, it is left in water for one day. The inner layer is then easily separated by hand, and after being dried, the raw material is carried up the valley on men's backs, as above-noted. It is again steeped in water, through which wood-ashes (walnut) are diffused, and heat is applied till the bark becomes soft and white. It is then removed and beaten with a mallet till it assumes the form of pulp, which is stirred round in a tub, and afterwards allowed to deposit on a cloth sieve or frame, one yard wide, which is finally put out to dry in the sun.

This *Daphne* is abundant on the Sutlej (upper and lower Kunáwar), and also in the valleys of the Pábar and Tonse, at an elevation of 4,000 to 7,000 feet. It is particularly abundant near Pangi, one stage beyond Chíni and from Mirn to Wanghtu, preferring exposed cliffs where little else will grow.

"The fibre of the bark, like that of its congeners, possesses great tenacity and makes strong ropes, which are used in Gurhwal, &c. A soft, smooth and tough-ish paper is manufactured by the process detailed above, and is the only kind procurable in Ladákh and on the frontier. * * * * * *

The better kinds are extremely strong, and are used for important documents, being durable and resisting the attacks of the fish insect (so called), hence this paper is well suited for public records and Herbaria. The process of making paper in Nepaul from *Daphne papyracea* (*cannabina*) is described in the Asiatic Researches (Vol. XV.) by DR. WALLICH, who figured the plants.* DR. HOOKER states the paper in Thibet is made chiefly from the bark of *Edgeworthia Gardneri*, and is imported from Nepal and Bhutan. In the same manner Ladákh is supplied from Kunáwar.

At Dhurmsalla Jail an allied species, "kanera," (*Daphne oleoides*) is used, and the paper prepared is of fair quality. The shrub grows about 3 kos from the station, and the supply has fallen short; and, consequently, the district court and kutcherry are only partially supplied at present with the *Daphne* paper, the fibre of which is supplemented by the use of "tât." The paper made at jail is sold at forty large sheets per rupee.

It is doubtful whether any material for paper-making could be exported profitably from the Punjab to England, the distance from the sea-board being so great: but the inner layer of the bark separates easily, and the paper made from it so nearly resembles cartridge paper (being strong and tough and not cracking or giving way when folded or rubbed) that it might be advisable to send a shipment to England of the

* See also Vol. II. of this work, under "Paper."

fibre of each species (say 1 ton of each) for trial and report. It will be remembered that the specimens showing the various stages of manufacture of the Nepal paper shrub (*D. papyracea*) attracted particular attention at the Kew Museum, and at the International Exhibition in London, 1862.

Of the uses of this plant good accounts have been given by MR. HODGSON (Journal Asiatic Society, I., page 8, 1832) and DR. CAMPBELL. The former describes the process as consisting, first, in boiling slips of the inner bark of the paper plant in a ley of wood ashes for about half an hour, by which time the slips will be quite soft. These are then beaten in a stone mortar with a wooden mallet till they are reduced to a homogeneous pulp. This is then diffused through water, and taken up in sieves and paper frames, as in the ordinary process for making paper by hand. When dry, the sheet of paper is folded up; sometimes it is smoothed and polished by being rubbed on wood with the convex side of a conch shell; but MR. HODGSON does not explain how the very large sheets of several yards square are made. Though called Nepalese, the paper is not manufactured in Nepal, but in Cis-Himálayan Bhote, in the midst of its immense forests, where there is an abundant supply of the plant, of wood for ashes and for firewood, as well as a constant supply of clean water. This paper is remarkable for its toughness, as well as its smoothness. Some of it, in the form of bricks of half-stuff, was sent to this country previous to the year 1829. As the quantity sent was not sufficient for a complete experiment, a small portion of it was made into paper by hand. An engraver, to whom it was given for trial, stated that "it affords finer impressions than any English-made paper, and nearly as good as the fine Chinese paper which is employed for what are called India paper proofs." (Gleanings in Science, I., p. 210). DR. CAMPBELL describes the paper, as made by the Bhoteahs, "as strong and durable as leather almost, and quite smooth enough to write on; and for office records, incomparably better than any India paper.

"It is occasionally poisoned by being washed with preparations of arsenic, in order to prevent the destruction caused by insects. Many of the books in Nepal, written on this paper, are said to be of considerable age, and that the art of making paper seems to have been introduced about 500 years ago from China, and not from India." He states, "that this paper may easily be procured at Patna, Purneah, and other places in the plains of both Southern and North-Western India."

1793.—[4787]. *Desmodium tiliæfolium.* Kangra Hills.

A pretty *Leguminous* shrub, with clusters of pale lilac flowers: the bark is used for paper-making (see *Plate*).

1794.—[4784]. Birch bark (*Betula bhojputra*). Kangra.

This thin white bark occurs in sheets or pieces which can be peeled off: it is used to made umbrellas, and said to be used for writing on. I have often received articles at druggists' shops wrapped up in birch bark, just as the leaves of the "palás" are used. Its chief value in native manufacture is the making of the snake or flexible huka pipes (necha pechwán), these consist of coils of iron wire wrapped over with birch bark, and then covered outside with silk, and ornamented.

The *Betula bhojpatra* grows at elevations of 9000 feet.

1795.—Leaves of *Zea mays* (maize); jawár (*Holcus sorghum*), &c.

The value of these as a paper fibre is illustrated in an extract from the "Times." *September 13th*, 1865.

The uses of Maize.—A hint to India. "The Austrian department of the International Exhibition has received very recently a most interesting augmentation in a collection of the products made from the leaves of the maize plant. This collection shows the head leaves of the plant, which hitherto had no useful application except as fuel or litter for cattle. These leaves, however, are capable of yielding a nutritive substance, or breadstuff, for human food; a fibrous material capable of being spun and woven like flax, and ultimately, a pulp from which a most beautiful paper can be produced. The collection shows maize fibres prepared and spun into yarn, some woven fabrics made of the same, and all kinds of paper produced from the leaves of this plant. The most important question as regards the practical utility of an invention of this kind is the commercial gain that can be derived from its application. The results of the experience gained till now are very satisfactory as to this point. The whole mass of the head leaves yields on an average one-third of its substance for spinning, one-third for paper, and one-third for food; waste there is nearly none. The whole of the fibrous substance may also be worked up into paper. The process as carried on in the Imperial Paper Manufactory at Schloegelmuehle, Lower Austria, gives a produce of 100 lbs. of paper from 300, lbs. to 350 lbs. of head leaves, irrespective of the other materials, and 1 cwt. of such leaves costs only 6*s.* when delivered at the paper factory. To produce the same quantity of paper about 160 lbs. of rags would be required. According to official returns there are 35,000,000

DESMODIUM TILIÆFOLIUM.

(*Nat. order.*—LEGUMINOSÆ.)

b, the flower

acres of land in Austria planted with maize, the annual product of head leaves from which is estimated at 2,750,000 cwts. If the whole of this is worked up into paper the yield would be enormous, exceeding 1,500,000 lbs. annually. So strong and durable is maize paper that if ground short it is even said it can be used as an excellent substitute for glass, so great is its natural transparency and firmness."

IV. SUBSTANCES USED IN MATTING AND THATCHING, &c.

1796.—[4926]. Fibrous leaf of date palm (*Elate silvestris* or *Phœnix silvestris*). Shahpúr (Khúshab).

The material of the leaves of palms is generally too strong to admit of the separation of the individual fibres, like the agave and pine apple; but this very property, and the narrow slips in which these leaves are formed, makes them singularly suitable for mat and basket weaving. Fans and mats are abundantly made of them. The best of them, however, are from the Peshawur *Pattá*, to be noticed presently.

Samples were sent from Lahore (4857). The palm leaf is found at Lahore, but this particular sample came from Múltán.

(4942) Gurgaon.

(4958) Dera Ghází Khán, called "patís."

1797.—[4959]. Palm fibre, "khajúr múnj" (*Elate silvestris*). Dera Ghází Khán.

A sample is sent from Muzaffargarh of the fibre, or rather fibrous involucre, the reticulum of the palm, entire (4948); it is called "kabál" or "khajúr ka bokla;" it is used to make pack-saddles for oxen, or the fibre separated is made into ropes. (For an account of the growth of the date tree, *see* under "Fruits." Art. Dates.) The strips of the tough fibrous leaf, which is the subject of the last number, are called in Muzaffargarh "bútra" or "pattra." It is noted as an article of great importance and general use in the district, as also in the lower Deraját.

A sample was sent from Delhi (4710), as "resha dirakht-i-khúrma."

1798.—[5416]. "Mazri tree" (*Chamærops Ritchiana*). Bunnoo, Shaikhbudín and Wazírí Hills (kílú and kaliún, Salt Range).

This is a fine specimen of the entire plant with its fruit or berries attached. The leaves and leaf-stalks enveloping the tree stem, yield in narrow strips, the tough fibre used for making mats, fans, and hand punkahs. The fibre is called "patha." Peshawur is the great place of production, and the imports of manufactured mats and punkahs from Peshawur to the great cities of the Punjab are very large.

The hard fruits and seeds of the tree are pierced for beads, and used by Mahommedans for rosaries.

(4927) A sample (pathá) from the Salt Range was exhibited by DR. HENDERSON, where it grows on Sakesar from 2,000 to 5,000 feet.

(4966) Peshawur.

(4860) An imported sample from Lahore.

1799.—[4968]. "Lukh," a reed (*Typha sp*———?) Peshawur.

This is a reed or flag, which is much used to make floor mats, just like the matting made out of *Typha elephantina* in the plains.

THATCHING MATERIALS.

1800.—[4871]. "Sarkara" grass. Lahore. IMAM BAKSH.

1801.—[4929]. "Sirki" grass. Shahpúr.

1802.—[4941]. "Kánná" grass. Guguira.

(4961) Dera Ghází Khán.

These specimens are all the parts of *Saccharum moonja* before alluded to.

The 1st, *sarkara*, consists of the tufty leaves or grass of the plant, which is different from the stem leaves and sheaths (múnj), and is only gathered in bundles for thatching purposes.

Sirki is the tapering end and flower head of the flower stem after the seed has been brushed off: these slender stem tops are placed close together, and side by side, and their ends cleverly secured together, by a binding of grass rope into which they are inserted. These are used as a kind of roofing or penthouse to protect the tops of carriages and wagons during the rainy season, and for various other purposes of roofing and shelter.

Kánná or *sarkanda*, is the thick culm, used to make "chicks" and furniture, as previously described: the fine parts of the culm are called in Muzaffargarh "tilí," and the pith from inside, called "*khillu*" or "*khál*," is eaten. The tops of the grass, as soon as it flowers, are given in this district to cattle, as it is supposed to increase the supply of milk.

It may be advisable to give all the names applicable to parts of this grass, so that the reader may see the varieties of name and usage at one glance. Beginning from the root, we have

1. The tuft of grass leaves, only used for thatching = *sarkara.*

2. The fine stem leaves, and sheaths enveloping the stem = *munj.*

3. The culm = *kánná* or *sarkanda* (finest part = *tili*, Muzaffargarh).

4. The upper end of the flower stalk after the downy flower seed is shaken off = *sirki.*

1803.—[4734].—"Khas." Ambálah district.

This is the "kuskus," or fibrous root of the *Anatherium muricatum*, used to make tatties. The root, when moistened has a pleasant fragrance; the oil of it is scented, and used in rheumatism, and a watery infusion is said to be refrigerent in fevers.

It is also much used as a packing material. The grass of the plant is called "khavi" and "panni," and the flower "izkhar." Specimens were sent from—

(4920) Jálandhar.
(4781) Kangra.
(4934) Phera of Shapúr.
(4962) Dera Ghází Khán (banks of the Indus).

1804.—[4788]. "Hill bambú (*Arundinaria utilis*), nirgal. Kangra hills, from 5,000 to 8,000 feet. LOCAL COMMITTEE.

I have placed this last as midway between a fibrous plant and a wood for Class (F).

Not only is its wood valuable, but it affords a fibre both for rope and for paper-making. An account of it is given by BARNES in his report, as follows, and further information will be found under the head "Bamboo" in Sub-class (F), (Woods).

"The wild bamboo is found in almost all the ranges that skirt the plains. There are extensive forests in the hills of Chokee Kotlehr, conveniently situated in the neighbourhood of the river Sutlej. Merchants from Loodeeana occasionally come up and cut them, and Government exact a fee of one rupee for every thousand. It appears again, in greater profusion, in talooquas Seeba and Dutarpoor, where considerable districts covered with bamboo, have been marked off as Government preserves. In talooqua Lodwan, near Pathankote, the same plant is scattered over the forests, mixed with other trees, and a dense thicket of bamboo, almost impenetrable, clothes the southern flank of the Asapooree hill, in talooqua Rajgeeree. In the Snowy range two or three diminutive species occur. One, called 'nirgal,' is used by the people for wicker work and for lining the inside roof of their houses; another kind, called 'girch,' is in request for the sticks of hookas.

"Besides these wild varieties, there are five different sorts of cultivated bamboo. Two of these, the "muger" and the "mohr," grow in the vallies, and attain a size and height not surpassed in Bengal: the other three species, called 'nall,' 'boatloo,' and 'phugloo,' are usually found in the upland villages. In the cylinder of the 'nall,' a substance sometimes coagulated, sometimes liquid, is discovered, known in Hindostan by the name of 'bunslochun,' and highly valued for its cooling and strengthening properties.

The following samples were exhibited by DR. W. JAMESON, and are included here, as several of them are capable of production, and actually have been produced in the Punjab.

1805.—Fibre of the *Sanseviera zeylanica* (Tiliaceæ). Saháranpúr.

This is the *múrva* of Bengal, and the *marúl* and *múrgavi* of Southern India.

The plant grows in jungly salt soil along the coast. It can be easily propagated by the slips that issue in abundance from the roots. It will grow almost anywhere, and is perennial. The leaves are from 3 to 4 feet long, and the fibre, which runs the whole length, is obtained by placing the leaves on a flat board or stone, and scraping off the pulp; after which the fibres are washed and dried, or the leaves may be steeped to decompose the cellular. This has been called by DR. ROXBURGH, "bowstring hemp" from the use it is put to in some parts of the country: the sacrificial cord of the *khsatrya* class (military) among the Hindús used to be made of this. The fibre is very strong: a line, 4 feet long bore 120 lbs., when a similar one of Russian hemp bore only 105, and the *Sanseviera* fibre after 116 days' maceration in water bore 30 lbs., when the hemp was completely rotten.

1806.—Fibre of the *Yucca gloriosa.*

These are similar to the agave fibres, and will take color well when dyed.

1807.—Fibre of *Agave cantala.*

1808.—Fibre of *A. Americana.*

These are accompanied by samples of the fibre dyed red and green, and also of a beautiful white matting made from them.

MAJOR DRURY gives the following account of *A. Americana* in his "Useful Plants."

"This is much used in the Madras Presidency. It is manufactured at a very slight expense, the mode of preparation being usually to cut the leaves and throw them into ponds for three or more days, when they are taken out, macerated and scraped with a bluntish instrument. It has been found that the leaf

fibres are liable to rot owing to a milky viscid juice contained in them. This defect has however been considerably obviated by very hard crushing, or pressure between heavy cylinders, which by getting rid of all the moisture renders them more pliable for weaving and other purposes. In Calcutta the fibres being submitted to experiments were found equal to the best Russian hemp. They are much used for lashing bales of calico. As log-lines for ships they are found to be very durable and far superior to ropes of hemp. In several experiments that have been made, especially by DRS. ROYLE and WIGHT, aloe fibre rope has been found to be more powerful than either coir, country hemp, or jute. A bundle of the agave fibre bore 270 lbs. that of Russian hemp only 160 lbs. DR. WIGHT found some cord of it bore 362 lbs. In Tinnevelly it sells for from 20 to 40 rupees the candy of 500 lbs., and at Madras for 7 rupees a maund. In 1853-54 were exported from the western coast 3,650 cwts., valued at 21,506 rupees. There is no doubt that these aloe fibres deserve more particular notice. They are admirably suited for cordage, mats, ropes, &c., and the tow might be advantageously used in the manufacture of paper. In Madras the plant is called the "peetha-kalabantha."

DR. ROYLE mentions that the hedges of the Botanical Gardens at Saháranpúr were made of agave. It seems peculiarly suitable for this purpose. It is commonly to be seen in gardens in the Punjab, as also "yucca," and there seems no reason why the cultivation should not extend over the Punjab. Labor is cheap, and the process of obtaining the fibre from the leaves simple and inexpensive.