Gregor Mendel
(1822-1884)

'The father of Genetics'

Presented by Junko Rielly

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1. Introduction

The plan of this report was introduced by Science Programme Leader John O'Neill and the collaboration of Mark Hetherington, Communication Lecturer as part of The Science and Technology in Society Unit. One scientific hero was chosen on personal interest, and the investigation on the subject and its impact on society were begun in September 2008 and the oral presentation was submitted in March 2009 followed by this report.

This report is about Gregor Johann Mendel (1822 – 1884) who made a great contribution to the society for the future generation, proposing the possibility of genetic inheritance by conducting plant hybridization. The importance of the discovery was not recognised at the time of his day but re-discovered in early 20th century by other scientists, which was when his study was brought into the spotlight and was after his death.

2. Research methods and Plan

Information for this report was taken from books and websites. Details are described in the bibliography. The plan was made and carried out as follows.

By 30/09/08 the topic of report and scientific heroes had been chosen.
By 27/10/08 the brief outline plan had been prepared.
By 25/11/08 the 200 words of summary was submitted.
By 17/02/09 the research of the topic was completed.
By 23/03/09 the power point presentation had been delivered.
By 01/06/09 the report had been submitted.

3. Main body

3.1 An overview of my chosen Science hero

Gregor Mendel was born in a peasant family in Brun, Moravia (now Czech Republic) in 1822. He worked as a gardener as a child and attended the Philosophical Institute in Olomouc between 1840 and 1843, where he was recommended to join as a novice in the Augustinian Abbey of St. Thomas in Brno. The abbey served as a regional intellectual centre at the time, and his idea of plant hybridization was acquired through the study of fruit-growing, viticulture and agriculture at the Theological College in Brun under the teaching and with an encouragement of the abbot of the monastry, Franz Cyrill Napp. Mendel gained a teaching appointment of Natural history and physics in Brun in 1854 after the study at University of Vienna. He began the experiment of plant hybridization by plant-breeding in 1856 and obtained the idea of heredity.
In 1865 he reported his "Experiment on Plant Hybridization" to the Natural History Society of Brno after 7 years of research. The paper was published in 1866, however, his idea was criticized, and largely ignored until the early 20th century.

3.2 An investigation of the work

“Experiments in Plant Hybridization”

The experiments were carried out over 29,000 plants and spent seven years to obtain the results. This was demonstrated by using a technique, Monohybrid cross, which made possible to observe the physical characteristic of offspring, and Mendel saw how the different traits were passed on to further generations through the species.

First, Mendel selected the best suitable plants to carry out this experiment: ‘pea plants’ (***Pisum Sativum***):

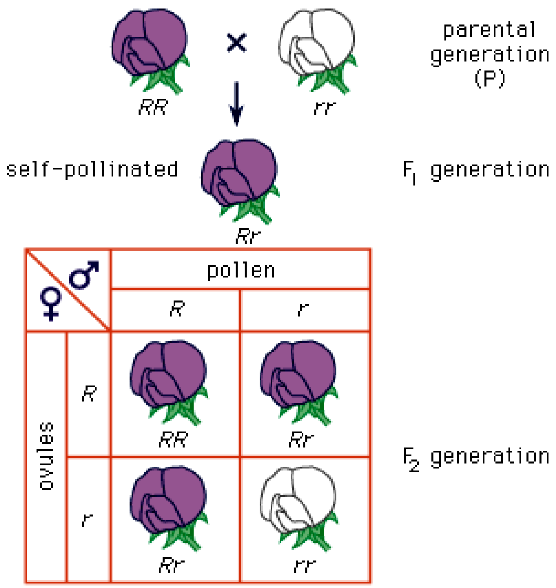
This plant was selected as it has constant differentiating 7 characteristics to demonstrate and find variations for the results.
They were;

1. the ripe seed is round or wrinkled
2. the seed’s colour is yellow or green
3. the flower colour is purple or white
4. the form of ripe pod is inflated or wrinkled
5. the colour of unripe pod is green or yellow
6. the position of the flowers is axial or terminal
7. the length of the stem is long or short.

It was also important that the hybrid flowers had to be easily protected from foreign pollen, and both the hybrid and the offspring easily obtained. This plant was an annual plant growing well in a cooler climate reaching maturity within 60 days after planting. That allowed Mendel to perform the planting experiments twice a year. It also had special properties that allow them to pollinate themselves; stamen (male reproductive organ) and pistil (female reproductive organ) were present in one flower, and the design was ideal for either cross-pollination or self-pollination. This experiment was carried out in the glass house in the blooming season in order to avoid second pollinator such as bees or other insects be interfered the experiments.

Secondly, Mendel carried out the ‘Experiments in Plant Hybridization’

The technique Monohybrid cross is the crossing over of 2 true-breeding strains which have only one characteristic difference. Here, it shows one of the crosses between a true-breeding lilac-coloured strain and white strain as an example.



The first generation (F1) was obtained by crossing the two parental strains, which resulted in all lilac coloured flowers. There were no intermediate forms obtained, which suggested the idea of 'dominant' and 'recessive' traits behind the physical characteristic later on.

The second generation (F2) was obtained by self-pollination with those of F1 offspring as parents, and the characteristic of the offspring e.g. flower colour is purple or white and the ratio were recorded.
Experiments on other traits were also carried out and the certain numeric ratio of F2 generation was obtained as follows:

1. Shape of ripe seed.
   From 253 monohybrid crosses, 7324 seeds were obtained. Among them were 5474 round and 1850 were wrinkled. The ratio was 2.96 : 1.
2. Colour of seed.
   258 plants yielded 8023 seeds, 6022 yellow and 2001 green obtained. The ratio was 3.01 : 1.
3. Flower colour (and seed-coats)
   929 plants, of which 705 purple flowers (grey-brown seed-coats) and 224 white flowers (white seed-coats) obtained. The ratio was 3.15 : 1.
4. Form of ripe pods.
   From 1181 plants, 882 inflated and 299 wrinkled obtained. The ratio was 2.95 : 1.
5. Colour of unripe pods.
   580 plants, of which 428 had green pods and 152 had yellow ones. The ratio was 2.82 : 1.
6. Position of flowers.
   Among 858 plants, 651 had axial and 207 had terminal. The ratio was 3.14: 1.

7. Length of stem.
   From 1064 plants, 787 had long stem and 277 had short stem.
   The ratio was 2.84: 1

The results of 1(shape of ripe seed) and 2 (colour of seed) are especially reliable to determine the average ratio, dominant : recessive = 3:1, with a large number of experimental plants. They suggested that one in four offspring appeared recessive in F2 generation, which was covered by dominant factor at F1 generation.

Mendel carried out further experiment with the 'dominant' phenotype (e.g. round seed shape) obtained from the F2 generation. Some of the results were shown below:

'Dominant seed shape'

Round seeds obtained from the F2 generation were used and 565 plants were raised. 193 yielded round seeds only and 372 yielded both round and wrinkled seeds. The constant number of dominant hybrid : the number of dominant hybrid but possessed other factor = 1: 1.93

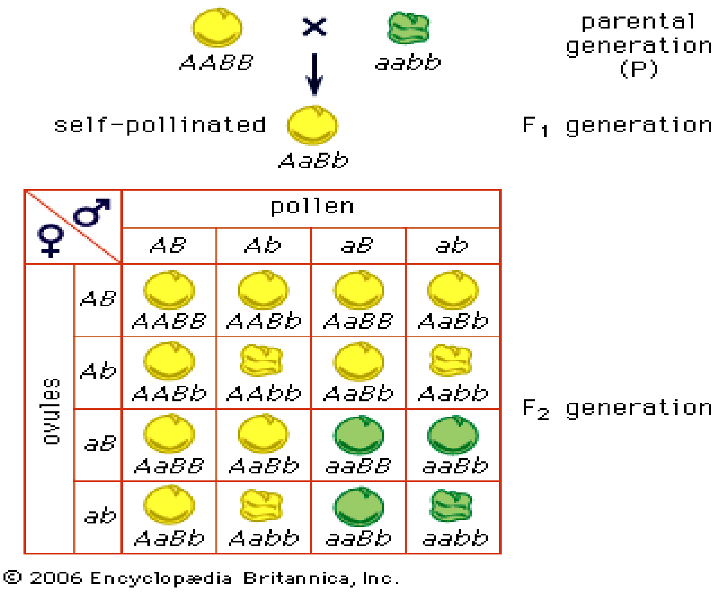
'Dominant colour of seeds'

519 plants were raised from the F2 dominant seeds, and 166 yielded yellow, and 353 yielded yellow and green. The constant number of dominant hybrid : the dominant hybrid but possessed other factor = 1 : 2.13

These experiments indicated that one in three seeds appeared constantly dominant. However, two out of three dominant phenotypic characteristics possessed other recessive 'factor'.

The following hypothesis was concluded:
F2 genotypic ratio =
1 dominant constant: 2 dominant hybrid: 1 recessive constant, whereas
F2 phenotypic ratio = 3 dominant : 1 recessive

He also demonstrated more complex crossing Dihybrid which is the cross between a parent that possess 2 different factors, e.g.Yellow round seed x green wrinkled seed). This experiment produced F2 phenotypic ratio of
9 yellow/round, 3 yellow/wrinkle, 3 green/round, 1 green/wrinkle, but the
9:3:3:1 following table shows each of the independent factors are inherited with a 3:1 ratio.



Mendel concluded these experiments in two forms:

Law of Independent Assortment (Inheritance Law)
Different traits are inherited independently of each other. So there is no relation and they are unchanged.

Principle of segregation
The alleles (factors) of a gene exist in pairs but when gametes are formed, the members of each pair pass into different gametes. Thus each gamete contains only one allele of each gene.

3.3 The impact of their work on society

When Mendel's paper was published in Moravia in 1865, it had little impact and was criticized. It was in early 20th century when the importance of his study was re-discovered by other scientists Hugo de Vries and Carl Correns, which was the start of considerable dispute. His study was worked out quickly genetically and divided biologist into two groups; Karl Pearson and W.F.R.Weldon leading biometricians whose idea were heavily based on statistical mathematical studies of phenotype variation, and William Bateson leading the Mendelians who claimed a better understanding of biology. In 1918 by R.A.Fisher the two different approaches were combined as evolutionary biology. Fisher threw doubt on Mendel's results after analysis but the dispute has continued being unsolved. It is now largely considered as the laws of inherited characteristics in modern biology.

4. Conclusions

Through this investigation Mendel's passion for the study of plants and the process of finding his idea of genetic inheritance was traced. Mendel was the first biologist who made me fascinated into the study of plant biology, and finding out his experiments and its influence in the society was most interesting.

5. Evaluations

Mendel is well known as 'the father of genetics' and it did not take time to find the basic information, but were most similar and difficult to find the variety. Most information was taken from website and chosen information was considered as genuine; especially 'Mendel web', Mendel's paper in English was translated from German, was very useful. His original paper was burned after his death so this information was vital and treated as reliable in this report. Reading this paper was confusing until it was found some of the 'word' he used in the paper was not matched the modern use of terminology.
It was fascinating to trace his life as a monk and scientist but I found the subject was difficult to discuss because his theory is now already regarded as the 'law'. The connections between his life, religion and the society at the time could have been investigated more, especially with the comparison of the idea behind Charles Darwin's theory which was published in 1859.
Writing report on the scientific topic was challenging and I have learned how to put information in the best logical order for submission. There were some obstacles during this project and the time management was difficult. Speech on the presentation was the most difficult and I would like to improve the skill with more practice. However the practices learnt in the class and my curiosity about Mendel's work encouraged me to explore the subject and to conclude the project.

6. Bibliography

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