Preface

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WHEN A MAP IS A MAP?

"That's another thing we've learned from your Nation", said Mein Herr, "map-making. But we've carried it much further than you. What do you consider the largest map that would be really useful?"

"About six inches to the mile."

"Only six inches" exclaimed Mein Herr. "We very soon got to six yards to the mile. Then we tried a hundred yards to the mile. And then came the grandest idea of all! We actually made a map of the country, on the scale of a mile to the mile!"

"Have you used it much?" I enquired.

"It has never been spread out, yet," said Mein Herr: "the farmers objected: they said it would cover the whole country, and shut out the sunlight! So we now use the country itself, as its own map, and I assure you it does nearly as well.

Lewis Carroll (1893) Sylvie and Bruno Concluded

The aim of the Preface is to show that "Falconer's book" (Falconer (1960, 1981, 1989); Falconer and Mackay (1996))

- ▶ has been a very good (text)book,
- ▶ it needs to be replaced with a new (text)book, and
- ▶ the new book should follow the successful tradition of Falconer's book.

Do we need a new book on quantitative genetics (QG)?

There is no doubt that Falconer's book (*Introduction to Quantitative Genetics*) has been a very successful and influential textbook. About 60 years after its first edition, Falconer (1960), and almost 25 years after its fourth and last edition, Falconer and Mackay (1996), it is still being referred to in its traditional fields (quantitative genetics, animal and plant

breeding), and many other fields, such as evolutionary genetics, genetic epidemiology, and behavioral genetics.

However, 25 years is a long time, especially, in a very active field of research such as QG (e.g. compare Lynch and Walsh (1998) and Walsh and Lynch (2018)). The theory of QG has been pushed forward partly because scientists from many "non-traditional" fields have brought their questions to QG, and partly because of the momentum created by the massive amounts of new data that quantitative geneticists need to analyze.

Unfortunately, the monumental work by Lynch and Walsh (1998) and Walsh and Lynch (2018) are too "voluminous" to be used in an introductory course as a textbook. It was the lack of a good modern textbook that spurred us to undertake the task of writing a replacement for Falconer and Mackay (1996). The first step in this endeavor is to find out why Falconer's book has been so successful, and how it can be updated.

Success factors of Falconer's book

Falconer's *Introduction to Quantitative Genetics* owes its success to a number of inter-related principles that permeated all four editions of the book.

Model simplicity/complexity

Falconer kept the model complexity to a minimum with a view of making his book "*useful to as wide a rage of readers as possible, particularly biologists who, . . . , have no more than ordinary mathematical ability*". Thus, the book could be used as an introductory textbook for advanced undergraduate and early postgraduate courses. Further, professionals from other fields could easily learn the basics of QG. By analogy to the text cited from Lewis Carrol, Falconer kept the balance between simplicity/complexity at an informative and usable level.

Shallow/deep discussions

Falconer's book started each subject from an intuitive conceptual definition, and an associated simple equation reflecting the core of that conceptual definition. Therefore, it was easy to grasp a subject before reaching the diverse operational definitions that might exist for the subject. The distinction between conceptual and operational definitions can be exemplified by the two concepts of heritability and inbreeding for each of which there are several, more or less, equivalent equations. Falconer's book also avoided the formal derivation of many equations with mathematical rigor, and tried to simplify the equations as much as possible.

Staying true (or not) to QG

Utilization of QG in other fields often requires knowledge in some neighboring fields. As an example, the use of QG in animal and plant breeding requires help from statistical theory (e.g. in the fields of estimation and prediction theories). Falconer, successfully resisted the temptations to venture out in such fields. Keeping the balance between QG and neighboring fields helped the reader to have the opportunity to acquire a grasp of core of QG, while other sources could fill the gaps for application.

Number of subjects

Falconer's book, despite its relatively small size (378 pages of main text, including end of chapter problems, in the 4th edition) has a wide coverage of core QG subjects, and also application areas. There parts of the QG theory that are missing from Falconer's book (see the next section). However, it could be argued that the balance between too few or too many has been crucial, and inclusion of some of the missing parts was in contrast to other success factors, and indeed might have been excluded on purpose.

Diversity of examples and refrences

Another success factor for Falconer's book is the use of examples from many different species and settings. Experimental (laboratory) animals and plants, as well as field data are used throughout the book. Even data from a specific animal species, commonly known as *"human"*, has been extensivley used in the book. Irrespective of the reader's background, Falconer's book privides a balance among the usage of examples from, and references to, many species and areas of research.

Updated/outdated

Ironically, different editions of Falconer's book could be considered as both very updated, and at the same time rather outdated at the time of their publication. The reason is (was) a general tendency to use the original publications on many subjects rather than using the latest research. This had ensured that the sources (literture cited), in the majority of cases, had sucessfully passed the test of time. The use of old references was balanced by using the latest experimental results, and the latest theoretical developments in the core subjects of QG.

What is missing from Falconer's book?

Given the long time that has passed since the last edition of Falconer's book (Falconer and Mackay (1996)), the passage of time has made its presence more pronounced. It also important to bear in mind that the structure of Falconer's book, even for the last edition, is much influenced by the decsions made prior to the first edition (the date at the end of Preface of the 1st edition is December 1958).

An important question for a new book on QG is whether the balance point chosen by Falconer (and later by Falconer and Mackay) for each of the above mentioned sucess factors are the right point for today's needs? If the right balance is not established, then the new book will be *"out of joint"*. The effects of passage of time can be categorized, at least, under four headings.

Scientific advances of the last 25 years

The obvious effect of the last 25 years is that QG, and all of its neighboring branches of science, including molecular genetics, population genetics, and statistical genetics have made tremendous amount of theoretical and experimental adavances. The most relevant adavances need to be outlined in a new body of QG theory.

Technical advances in molecular genetics

Scientific advances in the field of molecular genetics have brought about many technical advances that provide massive amounts of data useful for QG studies. It ahs been shown repeatedly in the past (e.g. Kuhn (1996), and Cohen (1985)) that technological advances are one of the prerequisites of advances in scientific theories.

Technical advances in statistical genetics

Apart from scientific advances in the field of statistical genetics, there are Information Technology tools that are now available to students of QG that were not avaiable to anyone in the *"old days"*. These include both hardware (e.g. desktop and laptop computers, and powerfull local, regional, and national server networks), and software (e.g. general statistical and special statistical gentics computer programs). These kinds of tools facilitate numerical analysis of lage amounts of data with all sorts of statistical methods and models. The technical advancements in this area have a profound impact on the choice of balance between opposing options in the success factors mentioned above. Many things that were complicated before, might be considered relatively easy now.

Technical advances in book writing

Modern techniques of book writing provide a plethora of tools for typesetting, use of color, inclusion of footnotes and sidenotes, and many other visually enhancing areas. The use of such tools is thought after because of the assupmtion that they add pedagogical values to a book. Probably the most important development is that nowadays books can be used *"electronically"*. Thus, cross-referencing in text, to specific elements of the book (equations, figures, cited literature, and so on) has become essential.

Main references

These are the books that have been used extensively in writing of this book. The list will be assembled when writing the book has finished.

Acknowledgements

To be written later.

<div align="right">

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