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# Foreword

“Learning doth make the minds of men gentle, whereas ignorance makes them churlish.”

Sir Francis Bacon, 1605

The diverse compilation of pre-molecular biological surgical experimentation with advanced stem cell regenerative medicine devoted to the craniofacial complex makes this a unique book. This work combines an historical record of the past with current and future aspirations of diagnosis, prognosis, treatment and prevention of disparities of development. Anomalies of craniofacial development are associated with one third of all congenital birth defects. Whereas most parts of the body are generally concealed below the surface, either by skin or modestly by clothing, the craniofacial complex is the most exposed region of the body, making its defects not only functionally significant, but also having a huge sociological and psychological impact.

Molecular biology and stem cell therapy have revolutionized the study of development and the therapeutic potential of regenerative healing of defects. Rapid advances in our understanding of genetic, molecular and cellular mechanisms underlying craniofacial development are now being translated into novel approaches for disease prevention, tissue repair and regeneration.

Bernie Sarnat’s pioneering experiments recorded in this book opened up the possibilities of understanding and modifying the developmental

distortions that current genetic and molecular biological expositions are revealing as the root causes. His co-author, James Bradley, has taken advantage of this tremendous biological background to implement therapeutic and surgical procedures to alleviate disabilities and deformations by employing the technologies of diagnostic capabilities rendered by radiology, CAT-scanning, MRI imaging, ultrasonography and ultimately genetically-based prognoses.

The variations of the components of the oro-gnatho-masticatory apparatus, both in their normal and abnormal development, whether of greater or lesser clinical significance, are manifestations of an assuredly genetical underpinning. Furthermore, epigenetic influences on gene expression patterns are being revealed in phenotypic portrayals of genetic inheritance, that, if defective, have been modified by Bernie Sarnat's experiments and James Bradley's surgical skills.

The initially relatively less complex experiments performed in the early mid-20th century by Bernie Sarnat have given way in the 21st century to insights being revealed *by the more sophisticated* experiments by the refinements of genetic microarray analyses, tissue culture technology, regenerative medicine, organ transplantation, laser lysing of tissues and robotically-controlled surgery in the hands of James Bradley. Bernie Sarnat's innovative experiments on bone biology that have been published over an astonishing 70 year period from 1940 to the present book in 2010 have been cited over 117 times in the research engine "Scopus", attesting to his enormous impact on craniofacial biological research. His work has provided the necessary infrastructural background that has allowed James Bradley to undertake the heroic surgical reconstructions described in this book. The combination of the seminal works of a pioneering biologist with those of a practicing plastic surgeon represented in this book provides a phenomenal insight into overcoming the traditional barriers between laboratory science and clinical practice that the two authors of this book have displayed.

To these variegated musings on the combination of basic sciences with surgical expertise exemplified in this book, the reader has a potential Lucullan feast of thought upon which to chew. As Sir Francis Bacon

observed: “Some books are to be tasted, others to be swallowed, and some few to be chewed and digested”. Enjoy the contents of this book.

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Bernard G. Sarnat was the John Hunter of 20th century plastic surgery. Like the celebrated 18th century English surgeon, considered the father of surgical research, Sarnat had an unquenchable curiosity based on observations made during his daily clinical activities. Ever logical, he then went to the animal laboratory to seek the answers.

After obtaining medical and dental degrees, he took his surgical training at the St. Louis shrine of plastic surgery led by Dr. Vilray Blair, recognized as the Father of American Plastic Surgery. This educational background, combined with his personal temperament, set the stage or provided the foundation for a lifetime of asking pertinent clinical questions regarding the growth of the craniofacial skeleton: How can one study the growth of the mandible, midface, orbits and cranial vault? Does the normal craniofacial skeleton grow differently than the abnormal? Does an abnormality in one component of the craniofacial skeleton set off a “domino effect” in contiguous structures? Are the individual roles of the bones, cartilage, teeth and soft tissue envelope integrated to achieve final craniofacial skeletal morphology? How does one produce phenocopies of pathologic craniofacial human conditions? Sarnat realized that these questions could be answered only in the laboratory.

It is remarkable how many animal models he developed — turtles, rats, gophers, lagomorphs, pigs, dogs, and primates. To answer these questions, he recognized that experiments must include craniofacially immature as well as mature animals. One then has to ask the question

whether these experimental findings were transferable to the human. For example, the rabbit can be a “bone factory”; the canine is predominantly a snout animal; only the primates have the circumferential orbit of the human.

Yet, Bernard G. Sarnat was not to be deterred. Over a career that spanned the last half of the 20th century, he studied the role of the condyle and the effect of neuromuscular function on mandibular growth; the contribution of the nasal bones, septum and paranasal sinuses and facial sutures in rabbit and primate midface development; the effect of globe enlargement in orbital development; and the role of the cranial and skull base sutures in cranial vault development.

His experimental designs were ever simple and intuitive — local surgical manipulation. It was only natural that, as a surgeon, he used the tools of his trade in an investigative manner — not unlike John Hunter’s transplant experiment with combs of cocks.

What resulted was an improved understanding of craniofacial growth and development — the interplay of functional parts determining skeletal growth. An excellent example is the development of the forehead in response to frontal lobe emergence in higher animals. From an evolutionary standpoint, higher animals needed a second story addition. As humans assumed the upright position, olfaction became less important and snout size decreased (and the hands became more complex!). The frontal bone and the enlarged cranial vault represent the skeletal addition for the ever-evolving cerebral cortex.

In many ways, Bernard G. Sarnat’s work set the stage for my generation of craniofacial surgeons. The distraction technique could be employed in the young patient with recognition that the severely hypoplastic mandible had little potential for growth and development. As surgeons, we learned that the midface in syndromic craniofacial synostosis, likewise, had little potential for growth. Consequently, the Le Fort III advancement technique could be employed in these patients at a young age to improve occlusion, relieve sleep apnea and restore facial aesthetics and the surgeon would not be interfering with midface growth.

And now this remarkable surgeon, in the ninth decade of his life, is working with an academic surgeon, who is two surgical generations

younger, in bringing this remarkable tale of research to print and to relate it to modern craniofacial surgery and to contemporary research in this area — it is truly a story of our specialty over 60 years. What a contribution to the discipline of craniofacial surgery by two surgeons whose work transcends two centuries of work!

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