

Editorial

Contemporary Synthetic Glycoscience: A Theme Issue Dedicated to the Memory of Hans Paulsen

Joachim Thiem

Institute of Organic Chemistry, Department of Chemistry, Faculty of Science, University of Hamburg,
Martin-Luther-King-Platz 6, D-20146 Hamburg, Germany; joachim.thiem@uni-hamburg.de

Annually, the biomass of the Earth, estimated to be about 200 billion tons, is nourished by photosynthesis and degraded via various pathways. The primary product, glucose, is transformed into a huge number of distinct and structurally complex mono-, di-, tri-, and oligosaccharides, which provide glyco-based molecules for nourishment, as well as structural units. Together, these constitute about 95% of the total biomass, and the remaining 5% is transformed into all the other organic components involved in Earth's life-cycles.

In addition, nature has provided an overwhelmingly large number of complex glycosylated components, which underpin the life and health of all animate beings. Thus, fascinating questions involving the operating sequences and mechanisms underpinning all life on Earth have encouraged chemists to synthesize and study increasingly complex glucose derivatives.

One of the dominant figures in this area was Hans Paulsen, based in Hamburg, Germany, who, over his decades-long career, dedicated himself and his research group to syntheses in carbohydrate chemistry.

This Special Issue compiles the work of former colleagues of Hans Paulsen from around the world, who exchanged ideas with him extensively and contributed seminal studies covering a variety of exciting developments in contemporary glycoscience. In this introduction, I will briefly comment on the studies in synthetic and analytical glycoscience compiled herein.

As has been known for decades, the expression of glycosyltransferases in cancer cells generates tumor-associated carbohydrate antigens (TACAs) [1]. For example, aberrant sialylation on cell surfaces is known to be associated with cancer progression. The over-sialylation of glycoproteins on cancer cells increases the number of interactions with specific sialic acid-binding immunoglobulin-type lectins (Siglecs) on immune cells. This results in the suppression of the immune response against cancer cells, known as immune checkpoint inhibition [2,3]. Wong et al., who have, for a number of decades, been among the leading research groups employing chemo-enzymatic syntheses for highly complex hetero-oligosaccharides [4], contribute a number of convincing scalable chemo-enzymatic approaches to the synthesis of DSGb5 and complex sialylated hetero-oligosaccharides. These sialylated glycans from cancer-associated glycolipids were used by Wong et al. to compose glycan microarrays [5].

Cardiac glycosides [6] have been used for centuries in clinics for the treatment of heart failure and cardiac rhythm disorders [7,8]. Yu et al., who are among the leading research groups devoted to the synthesis of complex steroid glycosides [9], demonstrate the total syntheses of the structurally challenging cardiac glycosides acospectoside A and acovenoside B [10].



Received: 18 November 2025

Revised: 21 November 2025

Accepted: 25 November 2025

Published: 1 December 2025

Citation: Thiem, J. Contemporary Synthetic Glycoscience: A Theme Issue Dedicated to the Memory of Hans Paulsen. *Molecules* **2025**, *30*, 4617. <https://doi.org/10.3390/molecules30234617>

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Glycosphingolipids (GSLs) in cell membranes function as important regulators of essential biological processes such as cellular recognition and signaling, cell differentiation, and proliferation [11–14]. Thus, the contribution of Guo et al. focuses on syntheses of β -lactosylceramide (β -LacCer) analogs as key intermediates in the study of complex GSL biosynthetic processes [15].

Brucellosis constitutes a serious zoonotic bacterial—and highly contagious—disease in many animals, including valuable cattle [16,17]. The binding of murine monoclonal antibodies (mAbs) to hexasaccharide fragments of epitopes of the *Brucella* O-antigen is soon to be explored in computational study [18]. Bundle, Wood et al. were able to identify stable binding modes, which further our understanding of the recognition mechanism [19]. In the future, designing synthetic glycomimetics and engineering epitope-specific antibodies *en route* to vaccine design might be possible.

Since the original Koenigs–Knorr glycosylation in 1901 (124 years ago [20]), a compelling number of improvements on, and alternatives to, this seminal reaction have been published. Almost every scientist working in the synthesis of glycosylated components is required to employ this reaction, and each will be likely to affirm the following statement from Hans Paulsen, made in 1982: “Although we have now learned to synthesize oligosaccharides, it should be emphasized that each oligosaccharide synthesis remains an independent problem, whose resolution requires considerable systematic research and a good deal of know-how. There are no universal reaction conditions for oligosaccharide syntheses” [21]. One of the more recent modifications made in chemical glycosylation is the “4K reaction” [22]. The studies of Demchenko et al. demonstrate further improvements to this glycosylation modification, employing iron(III) triflate as an efficient activator of thioglycosides in this reaction pathway [23].

An important issue in glycobiology concerns bacterial adhesion as the initial step of infectious diseases. A closer understanding of the mechanisms involved could be of interest in preventing the adhesion of bacteria, for example, by employing carbohydrate-based inhibitors to facilitate further breakthroughs in diagnostics and therapy [24]. Of particular interest are functional glycomimetics, which are suited to studying the details of carbohydrate recognition, such as the varying distances between multiple glycoligands [25]. In their contribution, Lindhorst et al. employed xylopyranosides as a scaffold for the presentation of two mannoside ligands of the bacterial lectin FimH. The chair conformation of xylosides could be switched between alternative conformations, thus flipping the ligands from a diequatorial into a diaxial position. Further, such conformational switches may function as advanced smart molecular tools with which to study structural binding conditions in carbohydrate recognition [26].

Essential for membrane functions, cell recognition, and the maintenance of the nervous system are gangliosides such as GM2 (GalNAc β 1-4Gal β 1-4Glc β -Cer). Some rare genetic lysosomal storage diseases—e.g., Tay-Sachs disease (TSD) and Sandhoff disease (SD)—occur due to deficient β -N-acetyl-hexosaminidase activity, leading to decreased catabolism of β -N-acetyl-hexosamine-containing ganglioside GM2 in the lysosomes and, consequently, causing damage to cells and tissues, as well as severe neurological symptoms [27,28]. A number of contemporary studies have aimed to express and purify human B4GALNT1, the enzyme that transfers the GalNAc residue in the β 1-4 linkage to the Gal β 1-4 residue of the gangliosides GM3, GD3, and other GSLs. A number of studies have focused on characterizing its activity and exploring its structural features via protein modeling and substrate docking. Brockhausen et al., for a complex of B4GALNT1 docked with its donor substrate, UDP-GalNAc, were able to determine the relevant amino acids near the docking site that were likely involved in UDP-GalNAc binding and catalysis [29]. Thus, further studies *en route* to drug development, including the kinetics of inhibition, toxicity, and drug delivery to neurons accumulating GM2, are to follow.

Cell membranes are embedded with a glycocalyx consisting of a complex mixture of glycoproteins, glycolipids, complex oligosaccharides, glycoconjugates, and proteoglycans. Thus, cellular processes, such as bacterial and viral infection, cancer metastasis, the modulation and activation of the immune system, tissue differentiation and development, and further intercellular recognition events, are controlled by glycoconjugates [30–34]. For mimicking the glycocalyx, the self-assembled monolayer (SAM) formation of carbohydrate derivatives on gold nanoparticles was selected, allowing for the study of carbohydrate–protein and carbohydrate–carbohydrate interactions. The novel modular approach reported here includes facile and rapid syntheses for linking spacers and carbohydrate derivatives, enhancing binding events. Immobilization was performed on biorepulsive aminoxy-substituted gold nanoparticles via the oxime formation of aldehyde-functionalized mono-, di-, and complex trisaccharides. Uniform gold nanoparticles could be obtained, and effective immobilization and binding studies were presented for concanavalin A. Through this novel approach, Thiem et al. revealed a number of advantageous perspectives to be taken on various biomimetic studies of carbohydrates and carbohydrate-based array development for diagnostics and screening [35].

The innate immune system is sensitive to lipopolysaccharides (LPS), which play a pivotal role in immune response [36]. Lipid A, composed of a mono- or di-phosphorylated di-glucosamine core with multiple fatty acid chains, anchors LPS into the bacterial membrane and is largely responsible for the toxicity of Gram-negative bacteria [37]. In their contribution, D’Orazio, Lay et al. present syntheses and a computational evaluation of a library of glycolipid analogues to *B. fragilis* lipid A, revealing a rationally designed approach to developing novel anti-inflammatory agents [38].

Pathogenic bacteria often utilize cell surface sialylation to evade the host immune system via molecular mimicry of the host sialo-glycoconjugates [39]. Human pathogen *Neisseria meningitidis* serotype B (NmB) expresses both the sialylated capsule and surface lipooligosaccharides—pivotal virulence factors [40]. In NmB’s sialylation pathway, CMP-sialic acid synthetase (CSS) is essential for sialic acid transfer. Along various routes (compare also e.g., [41]), functionalized derivatives of neuraminic acid β -methyl glycoside (Neu β 2Me) were synthesized as candidates for the inhibition of *N. meningitidis* CSS. Direct interaction with the enzyme was confirmed by saturation transfer difference (STD) NMR [42,43]. In their contribution, Jennings, Münster-Kühnel, and von Itzstein et al. provide data encouraging the further development of potential inhibitors for the treatment of bacterial meningitis [44].

Nature makes sucrose annually in virtually limitless quantities, the majority of which is consumed via the food industry. Further uses include the production of bioethanol, biodegradable surfactants, and polymers [45]. Application of this cheap raw material with 100% optical purity and eight genuine stereogenic centers for the synthesis of various sophisticated products is of particular interest [46]. In their review, Jaraosz et al. focused on approaches to the use of sucrose in the design of fine chemicals, the macrocyclic scaffold, and further-modified derivatives for various applications [47].

For the colonization of human organs, pathogenic bacteria use a multilayer cell envelope largely composed of glycans and their conjugates [48,49]. Most Gram-negative and some Gram-positive bacteria comprise a capsule largely composed of glycans and their conjugates [50]. Thus, the synthesis of spacer-armed phosphooligosaccharides, structurally related to the capsular phosphoglycans of pathogenic bacteria, is of particular interest (e.g., [51]).

In their extended review, Nifantiev et al. summarize our current understanding of the preparation and immunogenicity of neoglycoconjugates based on synthetic phospho-

oligosaccharides to foster prospects for the development of conjugate vaccines on the basis of synthetic phosphooligosaccharide antigens [52].

Acknowledging Hans Paulsen and his collaborators for their seminal study of glycoprotein biosynthesis, the final review by Brockhausen sheds light on their many individual and decisive contributions. The stepwise development is demonstrated via the continual interaction of synthetic and biochemical glycoscientists, resulting in cleverly designed components [53].

This Special Issue contains ten contributions discussing challenging topics pertaining to both syntheses [5,10,15,23,26,38,44] and analyses [19,29]. Additionally, the review articles included discuss the relevant aspects of sucrose-based components [47] and the immunogenicity of neoglycoconjugates [52]. The final feature review describes the numerous synthetic contributions of the Paulsen group to solving questions pertaining to glycoprotein biosynthesis [53]. In this Special Issue, a broad overview of contemporary glycoscience research is compiled, indicating the significant influence of this subject in natural products and heterocyclic chemistry, as well as its value in addressing broader issues in biology and medicine.

Funding: This research received no external funding.

Conflicts of Interest: The author declares no conflicts of interest.

References

1. Hakomori, S. Tumor-associated carbohydrate antigens. *Annu. Rev. Immunol.* **1984**, *2*, 103–126. [\[CrossRef\]](#)
2. Duan, S.; Paulson, J.C. Siglecs as Immune Cell Checkpoints in Disease. *Annu. Rev. Immunol.* **2020**, *38*, 365–395. [\[CrossRef\]](#)
3. Smith, B.A.H.; Bertozzi, C.R. The clinical impact of glycobiology: Targeting selectins, Siglecs and mammalian glycans. *Nat. Rev. Drug Discov.* **2021**, *20*, 217–243. [\[CrossRef\]](#) [\[PubMed\]](#)
4. Tsai, T.I.; Lee, H.Y.; Chang, S.H.; Wang, C.H.; Tu, Y.C.; Lin, Y.C.; Hwang, D.R.; Wu, C.Y.; Wong, C.H. Effective sugar nucleotide regeneration for the large-scale enzymatic synthesis of Globo H and SSEA4. *J. Am. Chem. Soc.* **2013**, *135*, 14831–14839. [\[CrossRef\]](#)
5. Liao, K.-S.; Zhou, Y.; Chung, C.; Kung, C.-C.; Ren, C.-T.; Wu, C.-Y.; Lou, Y.-W.; Chuang, P.-K.; Imre, B.; Hsieh, Y.S.Y.; et al. Chemical and Enzymatic Synthesis of DisialylGb5 and Other Sialosides for Glycan Array Assembly and Evaluation of Siglec-Mediated Immune Checkpoint Inhibition. *Molecules* **2025**, *30*, 2264. [\[CrossRef\]](#) [\[PubMed\]](#)
6. Albrecht, H.P. Cardiac glycosides. In *Naturally Occurring Glycosides*; Ikan, R., Ed.; John Wiley & Sons Ltd.: New York, NY, USA, 1999; p. 83.
7. Botelho, A.F.M.; Pierezan, F.; Soto-Blanco, B.; Melo, M.M. A review of cardiac glycosides: Structure, toxicokinetics, clinical signs, diagnosis and antineoplastic potential. *Toxicon* **2019**, *158*, 63–68. [\[CrossRef\]](#) [\[PubMed\]](#)
8. Hou, Y.; Shang, C.; Meng, T.; Lou, W. Anticancer potential of cardiac glycosides and steroid-azole hybrids. *Steroids* **2021**, *171*, 108852. [\[CrossRef\]](#)
9. Liu, B.; Bi, S.; Wang, J.; Xu, P.; Yu, B. Synthesis of acovenosides: Cardiac glycosides with potent antitumor activities. *Org. Lett.* **2024**, *26*, 8725–8729. [\[CrossRef\]](#)
10. Liu, B.; Xu, P.; Yu, B. Total Synthesis of Cardenolides Acospectoside A and Acovenoside B. *Molecules* **2025**, *30*, 2297. [\[CrossRef\]](#)
11. Hakomori, S.I. Structure and function of glycosphingolipids and sphingolipids: Recollections and future trends. *Biochim. Biophys. Acta* **2008**, *1780*, 325–346. [\[CrossRef\]](#)
12. Guo, Z. The structural diversity of natural glycosphingolipids (GSLs). *J. Carbohydr. Chem.* **2022**, *41*, 63–154. [\[CrossRef\]](#) [\[PubMed\]](#)
13. Ando, H.; Komura, N. Recent progress in the synthesis of glycosphingolipids. *Curr. Opin. Chem. Biol.* **2024**, *78*, 102423. [\[CrossRef\]](#)
14. Wenckes, T.; van den Berg, R.J.; Boot, R.G.; van der Marel, G.A.; Overkleeft, H.S.; Aerts, J.M. Glycosphingolipids—Nature, function, and pharmacological modulation. *Angew. Chem. Int. Ed. Engl.* **2009**, *48*, 8848–8869. [\[CrossRef\]](#) [\[PubMed\]](#)
15. Mohamed, B.; Rohokale, R.; Yan, X.; Ghanim, A.M.; Osman, N.A.; Abdel-Fattah, H.A.; Guo, Z. Synthesis of Azide-Labeled β -Lactosylceramide Analogs Containing Different Lipid Chains as Useful Glycosphingolipid Probes. *Molecules* **2025**, *30*, 2667. [\[CrossRef\]](#) [\[PubMed\]](#)
16. Maudlin, I.; Weber, S. *The Control of Neglected Zoonotic Diseases: A Route to Poverty Alleviation*; WHO/SDE/FOS/2006.1; World Health Organization: Geneva, Switzerland, 2006; p. 83.
17. Corbel, M.J. *Brucellosis in Humans and Animals*; World Health Organization: Geneva, Switzerland, 2006.

18. Ganesh, N.V.; Sadowska, J.M.; Sarkar, S.; Howells, L.; McGiven, J.; Bundle, D.R. Molecular recognition of Brucella A and M antigens dissected by synthetic oligosaccharide glycoconjugates leads to a disaccharide diagnostic for brucellosis. *J. Am. Chem. Soc.* **2014**, *136*, 16260–16269. [[CrossRef](#)]
19. Sood, A.; Bundle, D.R.; Woods, R.J. Towards Understanding the Basis of Brucella Antigen–Antibody Specificity. *Molecules* **2025**, *30*, 2906. [[CrossRef](#)]
20. Koenigs, W.; Knorr, E. Ueber einige Derivate des Traubenzuckers und der Galactose. *Ber. Deutsch. Chem. Ges.* **1901**, *34*, 957–981. [[CrossRef](#)]
21. Paulsen, H. Advances in selective chemical syntheses of complex oligosaccharides. *Angew. Chem. Int. Ed. Engl.* **1982**, *21*, 155–173. [[CrossRef](#)]
22. Demchenko, A.V.; De Meo, C. The 4K reaction. *Carbohydr. Res.* **2024**, *538*, 109102. [[CrossRef](#)]
23. Dent, A.R.; DeSpain, A.M.; Demchenko, A.V. Cooperatively Catalyzed Activation of Thioglycosides with Iodine and Iron(III) Trifluoromethane-sulfonate. *Molecules* **2025**, *30*, 3058. [[CrossRef](#)]
24. Fares, M.; Imberty, A.; Titz, A. Bacterial Lectins: Multifunctional Tools in Pathogenesis and Possible Drug Targets. *Trends Microbiol.* **2025**, *33*, 839–852. [[CrossRef](#)] [[PubMed](#)]
25. Müller, C.; Despras, G.; Lindhorst, T.K. Organizing Multivalency in Carbohydrate Recognition. *Chem. Soc. Rev.* **2016**, *45*, 3275–3302. [[CrossRef](#)]
26. Jaeschke, S.O.; vom Sondern, I.; Lindhorst, T.K. Bivalent Inhibitors of Mannose-Specific Bacterial Adhesion: A Xylose-Based Conformational Switch to Control Glycoligand Distance. *Molecules* **2025**, *30*, 3074. [[CrossRef](#)]
27. Ledeen, R.; Wu, G. Gangliosides of the nervous system. *Methods Mol. Biol.* **2018**, *1804*, 19–55. [[PubMed](#)]
28. Furukawa, K.; Takamiya, K.; Furukawa, K. Beta 1,4-N-acetylgalactosaminyltransferase-GM2/GD2 synthase: A key enzyme to control the synthesis of brain-enriched complex gangliosides. *Biochim. Biophys. Acta* **2002**, *1573*, 356–362. [[CrossRef](#)]
29. Abidi, I.; Kocev, A.N.; Babulic, J.L.; Capicciotti, C.J.; Walia, J.; Brockhausen, I. Characterization of Human Recombinant β 1,4-GalNAc-Transferase B4GALNT1 and Inhibition by Selected Compounds. *Molecules* **2025**, *30*, 3615. [[CrossRef](#)]
30. Ratner, D.M.; Adams, E.W.; Disney, M.D.; Seeberger, P.H. Tools for glycomics: Mapping interactions of carbohydrates in biological systems. *ChemBioChem* **2004**, *15*, 1375–1383. [[CrossRef](#)]
31. Varki, A. Biological roles of oligosaccharides: All of the theories are correct. *Glycobiology* **1993**, *3*, 97–130. [[CrossRef](#)]
32. Haltiwanger, R.S.; Lowe, J.B. Role of Glycosylation in Development. *Annu. Rev. Biochem.* **2004**, *73*, 491–537. [[CrossRef](#)]
33. Ohtsubo, K.; Marth, J.D. Glycosylation in cellular mechanisms of health and disease. *Cell* **2006**, *126*, 855–867. [[CrossRef](#)] [[PubMed](#)]
34. Simanek, E.E.; McGarvey, G.J.; Jablonowski, J.A.; Wong, C.-H. Selectin minus sign Carbohydrate Interactions: From Natural Ligands to Designed Mimics. *Chem. Rev.* **1998**, *98*, 833–862. [[CrossRef](#)]
35. Kopitzki, S.; Thiem, J. Synthesis and Characterization of Glyco-SAMs on Gold Nanoparticles: A Modular Approach Towards Glycan-Based Recognition Studies. *Molecules* **2025**, *30*, 3765. [[CrossRef](#)]
36. Di Lorenzo, F.; Duda, K.A.; Lanzetta, R.; Silipo, A.; De Castro, C.; Molinaro, A. A Journey from Structure to Function of Bacterial Lipopolysaccharides. *Chem. Rev.* **2022**, *122*, 15767–15821. [[CrossRef](#)]
37. Raetz, C.R.H.; Whitfield, C. Lipopolysaccharide Endotoxins. *Annu. Rev. Biochem.* **2002**, *71*, 635–700. [[CrossRef](#)]
38. Kenneth, D.; Santi, C.M.; Tanda, F.; Izzo, A.; Civera, M.; D’Orazio, G.; Lay, L. Synthesis and Docking Studies of Glycolipids Inspired by Bacteroides fragilis Lipid A. *Molecules* **2025**, *30*, 3927. [[CrossRef](#)]
39. Schauer, R.; Kamerling, J.P. Exploration of the sialic acid world. *Adv. Carbohydr. Chem. Biochem.* **2018**, *75*, 1–213. [[PubMed](#)]
40. Harrison, L.H.; Trotter, C.L.; Ramsay, M.E. Global epidemiology of meningococcal disease. *Vaccine* **2009**, *27* (Suppl. 2), B51–B63. [[CrossRef](#)] [[PubMed](#)]
41. Zbiral, E.; Schreiner, E.; Christian, R. Synthesis of the 4-acetamido-4-deoxy analogue of N-acetylneuraminic acid and its behaviour towards CMP-sialate synthase. *Carbohydr. Res.* **1989**, *194*, c15–c18. [[CrossRef](#)]
42. Mayer, M.; Meyer, B. Characterization of ligand binding by saturation transfer difference NMR spectroscopy. *Angew. Chem. Int. Ed. Engl.* **1999**, *38*, 1784–1788. [[CrossRef](#)]
43. Meyer, B.; Peters, T. NMR spectroscopy techniques for screening and identifying ligand binding to protein receptors. *Angew. Chem. Int. Ed. Engl.* **2003**, *42*, 864–890. [[CrossRef](#)] [[PubMed](#)]
44. Chopra, P.; Fühling, J.; Ng, P.; Haselhorst, T.; Dyason, J.C.; Rose, F.J.; Thomson, R.J.; Gerardy-Schahn, R.; Grice, I.D.; Jennings, M.P.; et al. Exploring the Scope of Functionalized N-Acylneuraminic Acid β -Methyl Glycosides as Inhibitors of Neisseria meningitidis CMP-Sialic Acid Synthetase. *Molecules* **2025**, *30*, 4329. [[CrossRef](#)]
45. Queneau, Y.; Jarosz, S.; Lewandowski, B.; Fitremann, J. Sucrose chemistry and applications of sucrochemicals. *Adv. Carbohydr. Chem. Biochem.* **2008**, *61*, 217–292.
46. Jarosz, S.; Pakulski, Z. The roadmap for sucrose—A very inexpensive raw product. *Adv. Carbohydr. Chem. Biochem.* **2024**, *86*, 1–13. [[PubMed](#)]
47. Jarosz, S.; Pakulski, Z. Sucrose-Based Macrocycles: An Update. *Molecules* **2025**, *30*, 2721. [[CrossRef](#)]

48. Fivenson, E.M.; Dubois, L.; Bernhardt, T.G. Co-Ordinated Assembly of the Multilayered Cell Envelope of Gram-Negative Bacteria. *Curr. Opin. Microbiol.* **2024**, *79*, 102479. [[CrossRef](#)] [[PubMed](#)]
49. Ribet, D.; Cossart, P. How Bacterial Pathogens Colonize Their Hosts and Invade Deeper Tissues. *Microbes Infect.* **2015**, *17*, 173–183. [[CrossRef](#)] [[PubMed](#)]
50. Cescutti, P. Bacterial Capsular Polysaccharides and Exopolysaccharides. In *Microbial Glycobiology*; Holst, O., Brennan, P.J., von Itzstein, M., Moran, A.P., Eds.; Academic Press: San Diego, CA, USA, 2010; pp. 93–108.
51. Khatuntseva, E.A.; Nifantiev, N.E. Glycoconjugate Vaccines for Prevention of Haemophilus Influenzae Type b Diseases. *Russ. J. Bioorg. Chem.* **2021**, *47*, 26–52. [[CrossRef](#)]
52. Khatuntseva, E.A.; Kamneva, A.A.; Yashunsky, D.V.; Nifantiev, N.E. Synthesis Immunogenicity of Pseudo-Oligosaccharides Structurally Related to Repeating Units of Capsular Phosphoglycans of Human Pathogens. *Molecules* **2025**, *30*, 3068. [[CrossRef](#)]
53. Brockhausen, I. Hans Paulsen: Contributions to the Investigations of Glycoprotein Biosynthesis. *Molecules* **2025**, *30*, 3735. [[CrossRef](#)]

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